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ABSTRACT

This review of research on nutrition education for school-aged children includes 17 articles published since 1980 and not included in two previous reviews (13 school-based and 4 outside of school). School-based studies included families and home environments, program institutionalization, using computer systems, knowledge-based studies, and studies of other school- and classroom-based nutrition education. The outside-of-school studies emphasized targeting families and knowledge-based programs. This review summarizes study findings; discusses advances since the last review (gains in nutrition education for school-aged children and nutrition education needs); and notes implications for nutrition education policy, research, and program implementation (what components of nutrition education programs are most effective in achieving behavior change and how to maximize the implementation and institutionalization of nutrition education programming). The report notes there have been significant advancements in the field since 1980. There are increasing numbers of such programs being evaluated in multi-ethnic groups, and the study of family influence is increasing. Researchers now know that nutrition education can impact student knowledge acquisition, and behavior change is possible. Behaviorally based programs with a theoretical basis are the most effective for achieving behavior change. The report discusses issues that pose important questions and challenges and examines various questions on how to implement and institutionalize effective nutrition programs for school-aged children. (Contains 113 references.) (SM)

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Nutrition Education for School-Aged Children: A Review Of Research

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**NUTRITION EDUCATION FOR SCHOOL-AGED
CHILDREN: A REVIEW OF RESEARCH**

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September, 1994

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TABLE OF CONTENTS

Executive Summary.....	i
I. Introduction.....	1
II. Background Information.....	2
III. Review of Articles.....	3
A. School-Based Studies.....	3
1. <i>Targeting families and the home environment</i>	
Luepker et al., 1988.....	3
Hearn et al., 1992.....	5
2. <i>Looking at program institutionalization</i>	
Devine et al., 1992.....	7
Resnicow, 1992.....	8
3. <i>With a community component</i>	
Kelder et al., 1995.....	10
4. <i>Using computer systems</i>	
Burnett et al., 1989.....	12
5. <i>Knowledge-Based</i>	
German et al., 1981.....	14
Green et al., 1991.....	14
6. <i>Studies of other school- and classroom-based nutrition education</i>	
King et al., 1988.....	15
Arbeit et al., 1992.....	16
Domel et al., 1993.....	17
Killen et al., 1993.....	18
Resnicow, 1993.....	19
B. Outside-of-School-Based Studies.....	20
1. <i>Targeting families</i>	
Baranowski et al., 1990.....	20
Wagner et al., 1992.....	21
2. <i>Knowledge-based programs</i>	

	Connor et al., 1986.....	23
	Anliker et al., 1993.....	24
IV.	Summary of Findings.....	24
V.	Discussion- Advances since last review.....	26
	A. Gains in nutrition education for school-aged children.....	26
	1. Focus on behavior change.....	26
	a. <i>Rationale for behaviorally-based programs.....</i>	26
	b. <i>The debate between traditional nutrition education</i> <i>and a behavioral approach.....</i>	27
	c. <i>Designing a behaviorally-based nutrition</i> <i>education intervention.....</i>	28
	2. Increase in minority and special-needs populations in nutrition education research.....	30
	3. Use of physiological endpoints.....	31
	4. Family involvement in nutrition education.....	32
	5. Community involvement in nutrition education.....	33
	6. Innovative nutrition education programs.....	33
	a. Use of computers.....	33
	b. Alternative settings for delivering nutrition education programs.....	34
	B. Needs in nutrition education.....	35
	1. Tools needed for evaluating eating behavior change.....	35
	2. Targeting multi-ethnic groups.....	35
	3. More work is needed with families.....	36
	4. Functional meanings of foods.....	36
	5. More work is needed in communities.....	37
VI.	Implications for nutrition education policy, research, and program implementation.....	37
	A. What components of nutrition education programs seem to be the most effective in achieving behavior change?	37
	1. Programs are behaviorally-based and theory driven.....	38
	2. Programs for older students use a self-assessment component.....	39
	3. Family involvement is incorporated for younger students.....	40

4. Attempts are made to intervene on the school environment.....	41
5. Attempts are made to impact the community.....	43
6. Larger doses of intervention result in greater impact.....	44
 B. How can we maximize the implementation and institutionalization of nutrition education programming?.....	45
1. Who should deliver school-based nutrition education?....	46
2. Should nutrition education be integrated into subjects?...	47
3. How does nutrition fit into comprehensive school health?...	48
4. How do we diffuse and institutionalize programs?.....	49
 VII. Conclusion.....	50
 References.....	53

List of Tables and Figures

Table 1- Intervention Summary

Table 2- Evaluation Summary

Table 3- Study Outcomes

Table 4- Suggested Nutrition Intervention Components

Figure 1- Recommendations made by previous review articles

Figure 2- Merging behavioral and cognitive strategies in nutrition education

Figure 3- Psychosocial factors for youth health promotion

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Executive Summary

This review of nutrition education for school-aged children included 17 articles published since 1980 and not included in the two previous reviews in this area. Thirteen of the studies were school-based programs, while four were outside of school. Four included a family component.

Advances in the field

The review determined that there has been significant advancement in the field in some important areas. Increasingly, programs are developed using a behavioral focus and include outcome measures assessing knowledge, attitude, and behavior change. Several of the articles reviewed used a physiological endpoint to measure effectiveness of the nutrition education program.

In addition, work continues to examine ways to get families involved with nutrition education for children. Articles are included with the nutrition education message originating in the school and being carried home to families, as well as messages originating in family-based interventions which are designed to influence children's eating behaviors.

In addition, this review includes one article showing that a community-based intervention, with a school component, can have significant effects on adolescent food choices. This research was longitudinal, measuring a cohort over consecutive seven years.

In general, research methodology is improving. Control groups and more sophisticated data analyses strengthen the internal validity of the studies and allow better detection and interpretation of results. In some cases, follow-up measures are included to assess maintenance of effects. External validity is strengthened by research conducted in multiple sites or states.

This review reports on many nutrition education programs that were implemented with multi-ethnic populations of school-aged children, a needed move in nutrition education research. Nine of the articles reviewed include at least 20% of a non-Caucasian sample. In most cases there is little mention, however, of using different intervention strategies or looking at outcome results by ethnicity.

Some innovative programs using interactive computers or using after-school settings for nutrition education program were revealed. Work on innovative approaches is needed to continue building on what was learned in these early tests. In particular, computerized nutrition education activities or activities that can be of short duration and child-centered might be useful in settings where teacher or leader time is limited. In addition, some work has begun on developing nutrition education programs for alternative settings such as after-school programs and summer camps. While results of these studies were not positive with regard to behavior change, they do add to our understanding of what alternate setting programs must look like.

Needs in the field

In addition to the gains that are evident, questions and concerns do remain. One area that needs more development is designing evaluation tools to measure eating behavior change. As more and more programs appropriately attempt to affect behavior, the need for good evaluation tools become paramount. A call is made to develop simple checklists or food-record tools that are evaluated for reliability and validity. We can not determine if our programming is successful if we are unable to measure change. In addition, more work should be done looking not solely at behavior related to intervention strategies but to include measures of children's overall eating patterns which might be affected by nutrition education programs.

As previously mentioned, there is little evidence to suggest that interventions are being targeted to multi-ethnic or multi-cultural groups or that outcome differences by ethnicity or cultural background are being examined. This type of work is needed to maximize the benefit of nutrition education for multi-ethnic and cultural groups. Physiological risk factors differ by race, ethnicity and SES; our nutrition education interventions cannot assume a "one size fits all" approach. The prevalence of children living in poverty is on the rise in the United States. This condition cuts across ethnic, cultural and racial lines. Nutrition education programs of the 90s will be challenged to develop effective interventions for three strata of children: 1) those that are at risk because of over consumption of less healthful foods because of choice and habit, 2) those that are at risk because of over-consumption of less healthful foods caused by lack of opportunity or under consumption of healthful foods because of poverty and 3) those that are not at risk but need good foundations on which to solidify and reinforce their healthy eating habits.

More work with families and the larger community is suggested. Younger children's food choices are constrained by foods that are available in their homes. Families must learn how to have healthful foods available, be motivated to make healthful foods available, and see a benefit to their actions.

Children learn eating behavior by observing actions and reinforcements of those they see in their larger environment. Communities must provide better modeling of healthful nutrition and health behavior and improve reinforcements and incentives for making good food choices. As families and communities we need to be aware of the influence the media has on shaping our food choices. Children in particular are vulnerable to the barrage of food advertisements that market high fat and less nutritious foods with very effective social influence techniques (modeling, portraying eating certain foods as cool, or providing tangible incentives for purchasing their product).

While there is some work being done at the junior and senior high levels, more innovative nutrition education programs are needed. Programs that address functional meanings of eating in the context of social or emotional needs may provide interesting avenues of nutrition intervention and research. Use of peer-led nutrition education programs for older students possibly using behavior modification strategies may be appropriate.

Nutrition education experiences that focus on counter-advertising are needed. Similar work has been done with cigarette and alcohol advertising but very little has been done to help students understand and combat the messages they receive about food from the media.

Elements of successful nutrition education programs

Examination of the nutrition education research for children suggests that six elements are related to effective programs.

The first element is effective programs are behaviorally-based and theory driven. The studies that have been effective in achieving behavior change are those targeting specific behavioral messages such as eating lower-fat, lower sodium, higher complex carbohydrate foods or more fruits and vegetables. More general programs targeting overall improved nutrition (i.e., food groups) have been less successful. In addition to targeting specific foods, behavioral interventions based on social learning theory and including goal setting, reinforcements and incentives, modeling of appropriate behaviors and efficacy-enhancing experiences are effective.

In older students, activities that allow self-assessment of one's diet have been effective in achieving behavior change. This kind of activity is most appropriate for junior or senior high students as they are more capable of abstract thought and understanding causal relationships.

A third finding is that, for elementary-aged children, nutrition education interventions with a family component are feasible and facilitate changes in children's eating behavior. Little, however, is known about how children's nutrition education affects family eating behavior.

Fourth, there has been some success with comprehensive programs that include classroom as well as modifications of the school cafeteria program. School cafeterias can act as learning laboratories for nutrition education, offering students both the opportunity to choose healthful foods as well as providing normative support for such choices. The next decade will expand the relationships that are developing between classroom and cafeteria.

There is also some evidence that programs that attempt to impact at the community level will have better success in achieving healthy eating behavior change with children. Schools cannot be expected to carry the burden of changing children's eating behavior when children's larger environment has so much influence on beliefs, attitudes and values surrounding food, eating and health. Several ways to work on improving the community influences for healthy eating behavior include: looking at schools' policies regarding food related activities, testing more worksite wellness programs with schools as worksites, and looking at media representation of food and eating behavior.

Finally, literature to date indicates that "more is better" with regard to exposure to nutrition education. The Know Your Body program showed significant behavioral and physiological changes in students exposed to a multi-

year, weekly, behaviorally-based cardiovascular risk reduction program. Struggling to find time for nutrition and other health curricula continues to be a very difficult challenge.

The issue of implementation and institutionalization has not been adequately studied, possibly because the field is still trying to determine how to create effective interventions. This document discusses four questions related to implementation and institutionalization.

First is the question of who should deliver school-based nutrition education? While teachers are most often called into service to teach nutrition education their interest, skills and backgrounds are highly variable. If teachers are to teach nutrition education they must receive adequate training and support for delivering curricula as designed. Health educators or nutrition specialists hired at the school or district level might be good resources for teaching nutrition education but not without substantial cost.

Another question relates to integrating nutrition into other subjects. This approach has appeal in the ever-busy school day, crowded with other curricula and program needs. Designing, evaluating, implementing and institutionalizing such programs is very difficult and evaluation of integrated programs is limited.

Nutrition education has also been part of comprehensive school health programs; some of the most effective nutrition interventions to date have been part of comprehensive school health initiatives. Again, resource allocation, time in the curriculum, and well trained teachers for implementing comprehensive school health programs must have support at the federal, state, district and school levels. If comprehensive school health becomes a reality, questions related to what years nutrition is taught, how nutrition fits in a scope and sequence chart, and the time devoted to nutrition must be worked out.

Much less is known about how to maximize and institutionalize programs. This review reports two articles evaluating the effectiveness of programs when implemented without research-based support. The findings highlight that evaluated programs are not always implemented as designed once disseminated in non-research settings.

Substantial advancements have been made in designing effective nutrition education for school-aged children, particularly for elementary-aged children. More work is needed on developing effective programs for junior and senior high students. A great deal of thought and work needs to be conducted in how to make our families and communities better places for children to learn about and practice healthy eating behaviors. In addition, a great deal of work is needed in maximizing the implementation and institutionalization of effective nutrition programs. The ultimate goal of nutrition education must be to be effective, efficient and feasible in practical application. The real impact of nutrition education must occur outside of the research arena and within the typical classroom setting.

I. INTRODUCTION

This literature review of nutrition education for school-aged children was conducted for the USDA Food and Nutrition Service to provide insight into two far-reaching questions: Does nutrition education work? and What additional information is needed to develop nutrition education policies and plan effective programs?

This literature review builds on and incorporates findings from three reviews of nutrition education for school-aged children conducted by Saylor, Coates, Killen, and Slinkard (1982), Lytle Trenkner and Kelder (1991) for the American Cancer Society, and Contento, Manning, and Shannon (1992) for the Journal of Nutrition Education, Special Issue on Nutrition Education Research.

A library literature search was conducted using 1980 until present as the relevant time period. Even though the previous reviews cover 1980-1991, the literature prior to 1991 was searched again in case some relevant articles were missed by the earlier reviews. The search for materials to be included in the literature review was broad and comprehensive. We searched several databases, consulted numerous reference librarians at multiple libraries, and asked several other nutrition professionals to review our final reference list and suggest any relevant articles which we might have omitted. A valuable resource for nutrition literature searchers is Updegrave (1990), which provides a detailed list of databases as well as discussion of search strategies, suggested keywords, and contacts for further information about several databases.

Our search focused primarily on the AGRICOLA, Medline, and CRIS databases, with supplementary materials culled from ERIC and Psyclit. AGRICOLA is a comprehensive database produced by the National Agriculture Library and is the primary database for nutrition education materials, Medline is produced by the National Library of Medicine, and CRIS includes information on current and recently completed research projects supported through the USDA or the State Agricultural Research System. ERIC and Psyclit are education and psychology databases produced by the U.S. Dept. of Education and the American Psychological Association, respectively. These databases were suggested both by the USDA and by several librarians as good sources of information about nutrition education programs for school-aged children. Our search strategies were comprehensive, including such keywords as nutrition, education, school, child*, adolescen*, student*, health promotion, evaluat*, outcome, curricul*, feeding behavior, and health education.

Upon retrieving materials which met the criteria of our search, we examined the reference lists of these articles and found a few more relevant citations. After compiling our working reference list, we asked seven child nutrition experts to review it and suggest relevant materials which we might have omitted. Through this careful process we compiled a comprehensive list of resources related to nutrition education among school-aged children.

Articles were included in the review if they met the following criteria: a nutrition education program was delivered to children from kindergarten through high school ages within or outside of a school setting; a control group was included in the research design; an outcome evaluation (knowledge, attitudes, or behavior) was reported rather than a process evaluation or description of the intervention without evaluation; and the nutrition education program was not directed at high-risk youth (i.e., pregnant teens, youths with eating disorders, youth at high risk for cardiovascular disease) but rather had a prevention focus.

The review resulted in seventeen relevant articles, all found in peer-reviewed journals. A number of state Nutrition Education and Training Program reports were collected and reviewed (Texas, Nebraska, Massachusetts, and Maryland) but were not included in this review because outcome evaluations using a control group were not conducted.

II. BACKGROUND INFORMATION

Since 1980, three reviews of the state of nutrition education have been conducted. Each review included a set of recommendations (Figure 1).

Insert Figure 1 about here

Guidance provided by Whitehead in 1957 was visionary and is mirrored in all subsequent reviews. On the intervention side of the recommendations, nutrition education reviews have all encouraged behaviorally-based programs which attend to the influence of school-based programs not only on children's eating behavior but on the larger community as well. The more recent reviews have highlighted the need for adequate training of those individuals administering nutrition programs and development of nutrition education materials and interventions which target hard-to-reach youth., development of conceptual frameworks, and attention to scope and sequence of cognitively-appropriate programs. One reviewer calls for nutrition education to be seen in a broader context of health education with a holistic approach to overall health and well-being.

A recommendation that was brought out by several reviewers was the need to use theory in the development of nutrition education programming (Contento et al. 1992; Lytle Trenker et al. 1991). Achterberg and Clark (1992) discuss the role of theory in nutrition education and find that the majority of published articles on nutrition education do not cite a theory or model guiding the research. They call for development of a set of theories specific to nutrition education.

The most prevalent theory guiding nutrition education is Social Learning Theory (SLT), also referred to as Social Cognitive Theory (SCT) (Bandura, 1977, 1986). This theory is very useful since it offers some clear direction for developing behavior change interventions. For example, a major construct in SLT is reciprocal determinism, which posits that the individual, behavioral

responses by the individual, and the environment are in a constant, interactive relationship. This concept may help nutrition educators think about how the environment (including the social and physical environments) influences a child's eating behavior and how the individual can also influence the environment (e.g., children can learn to ask for lower fat milk in the home). In addition, SLT includes concepts surrounding how behaviors are learned, reinforced, and maintained (i.e., modeling, efficacy-enhancing experiences, and goal setting), giving the nutrition educator insight into how to achieve behavior change while also reinforcing and maintaining the change.

On the evaluation side, all reviews have stressed the need for improved research design and methodology in nutrition education research. All reinforce the need to measure cognitive, attitudinal, and behavioral outcomes. More recent reviews call for the need to conduct longitudinal research, to examine what strategies are most effective for different cultural groups and to conduct more qualitative research with children to determine motivations and concerns regarding eating behavior.

A multitude of groups develop nutrition education materials for children, ranging from the individual classroom teacher or Head Start worker who has an interest in nutrition and develops a nutrition education unit for their class, all the way to multi-million-dollar chronic disease prevention programs funded by the National Institutes of Health (NIH). The programs that conduct an impact or outcome evaluation to test effectiveness are limited and most typically are those programs funded by federal or state agencies. In addition to NIH-funded research, the Nutrition Education and Training program (NET) offers money to states through a system of grants for the development of comprehensive nutrition education. This federally legislated program enacted in 1977 requires NET funding to be used for programs on instruction of students, training of school food service personnel, inservice education of teachers and other school staff, and the identification of nutrition education resources (Kalina et al, 1989; Troccoli, 1993). Evaluation of the NET program is limited in part due to each state's freedom to use the NET money to serve their own state's needs, and in more recent years by a decrease in federal funding for the program. Only one national study of NET's effectiveness has been conducted to date by ABT Associates using data primarily from Georgia and Nebraska (St. Pierre and Rezmovic, 1982). Other food industry and state and local sources produce nutrition education materials; evaluation of these programs is limited.

III. REVIEW OF ARTICLES

Seventeen articles are reviewed. They have been grouped by school-based and outside-of-school nutrition education programs. Subcategories within each of the two divisions are identified.

A. School-based studies-

1. *Targeting families and the home environment*

Luepker et al.(1988)- This article looks at the effectiveness of a nutrition education program, including classroom and home components, in changing sodium consumption of 3rd-grade students. Thirty-one schools in Minnesota and North Dakota participated in this study. Schools were randomized into one of four conditions: control, school-only, home only, and school plus home. A pre-post design with a one year follow-up was used to evaluate outcomes.

The curriculum was a five-week, 15-session curriculum called Hearty-Heart and Friends (HH), which was taught by classroom teachers. (Hearty-Heart and Friends' effect on total fat, saturated fat, complex carbohydrates, and knowledge was previously reviewed and reported in the Lytle Trenkner and Kelder review, 1991). Changes in specific environmental and behavioral factors were targeted with students learning the concept of sometimes and everyday foods, food preparation skills, and experiencing modeling of healthful eating and exercise behaviors by cartoon characters. The salt message was targeted by the character "Salt Sleuth," who modeled how to look for hidden sodium in foods and how to read labels for salt and sodium content.

The home component, Home Team (HT), consisted of five weekly activity packets which were mailed home. The packets attempted to involve families in learning about heart healthful eating, including reducing salt and sodium intake. Students and families received points for completing activities.

The effectiveness of the programs was assessed by measuring knowledge, behavioral skills, self-reported food selection, height, weight, and skinfold thickness in all students in the 31 schools pre- and post-intervention. This analysis used a cohort design, with the analysis of results including only those students present for all measurement periods. In addition, two randomly selected subsets of students at each measurement period provided either an overnight urine specimen or urine plus a 24-hour recall. This analysis used cross-sectional results for reporting effect.

Results for the knowledge measurement show that students in the school-only (HH) condition and students in the school-plus-home (HH & HT) condition showed significant knowledge gains as compared to the control group. The home-only (HT) condition showed significant gains only in questions regarding high-salt foods and label reading as compared to control schools. The behavioral measure of salting foods showed little intervention effect and the 24-hour recall showed small but significant increases in milligrams of sodium per 1000 kcals in the HH group and small but significant decreases in milligrams of sodium per 1000 kcals in the control group. Urinary sodium excretion decreased in all but the HH group, but change between pre and post measures was not significant.

This study uses a factorial design to test the independent and combined effects of a school and family intervention to reduce sodium consumption. Physiological, behavioral, and knowledge assessments were conducted to

determine the effectiveness of the intervention. Results suggest that the school-based program, independently or in combination with the family program, yielded a significant change in knowledge. The ability of either intervention to result in behavioral or physiological changes was not consistently demonstrated. The authors note that other work with the Hearty Heart curriculum and the Home Team curriculum has resulted in significant decreases in total calories from fat as well as percent of calories from saturated fat and monounsaturated fat (Perry et al. 1988). The less favorable results for sodium intake are suggested to be due to: 1) intervention activities aimed at reducing salting behavior at the table or in recipes were not targeting the highest salt sources in children's diets; 2) sodium intake in this population was already lower than previously estimated causing little chance for a significant intervention effect; or 3) the intervention was not powerful enough to encourage behavior change.

The primary limitation of this study is limited generalizability; the population studied was a primarily white, mid-western population.

Hearn et al. (1992)- Hearn et al. report on feasibility testing of the family component of the Child and Adolescent Trial for Cardiovascular Health (CATCH). CATCH is a multicentered school-based health promotion program designed to test the effectiveness of classroom, family, and school environmental changes for affecting cardiovascular risk reduction (Perry et al. 1990). As part of the pilot phase of CATCH a pre-post survey was administered to a 50-percent stratified sample of families in the four field sites: California, Louisiana, Minnesota, and Texas.

The family intervention described in this pilot work involved take home activity sheets for 3rd- and 4th-grade students. These sheets complemented concurrent classroom-based activities and attempted to involve families in heart healthful behaviors related to eating and activity. The 3rd-grade intervention, Hearty Heart Home Team, used five weekly take-home activity packets. Each packet included an adventure story reinforcing and modeling heart-healthy activities, games, opportunities for families to practice new behaviors, a heart-healthful recipe, and tips for behavior change and goal setting. Families received points for completing activities together. The 4th grade activity packets, Stowaway to Planet Strongheart, were similar in content and scope and were distributed every two weeks for twelve weeks.

Measures included process-type measures as well as self-report outcome measures. The process measures looked at sociodemographic and behavioral indices to see if these factors were related to level of participation in the program. In addition, behavioral measures were examined pre- and post-intervention to determine program impact on children and family behaviors.

Of the 554 families eligible for participation in the survey, 77 percent had complete pre and post data. There were significant site differences in ethnicity of the families; the majority of families were White, with representation of Black, Hispanic, and other ethnic groups. Of the 424 families with pre and post data, 75% reported participating in the home activities.

Significant correlates of participation were: parents aged 35-44 as opposed to older or younger parents, higher educational levels, parents in professional occupations, and being White. Behavioral indices and self-reported food intake and exercise patterns did not discriminate participants from non-participants. Likewise, families' pre-intervention confidence estimates of ability to make behavioral changes with regard to eating or exercise were not significant predictors of participation. Ten measures of parental support or role modeling targeting specific eating or exercise behaviors (e.g., checking food labels, giving rewards for healthful eating, offering fresh fruits or vegetables) were examined for their relationship to participation in the program. Only offering fresh fruits and vegetables emerged as significantly related to participation in the program.

When pre-post change was examined, there were statistically significant reported changes in children's consumption toward more fresh fruit and less sugary desserts and snacks, fried foods, and whole milk. The same changes were seen in parental consumption patterns; in addition, parents reported consuming more skim milk. Of the ten measures of parental support or role modeling, significant increases were seen in giving rewards for healthy eating, giving rewards for exercising, cutting down on fat intake, and shopping for low fat foods.

This pilot study is important as it gives insight into what predictors are important for family participation in a school-based health education curriculum. The results suggest that families with lower SES backgrounds and Black and Hispanic families might require additional incentives and reinforcement for participation in such programs. Alternatively, other modes of reaching such families need to be considered and tested. Families' current level of healthful behavior or attitudes toward ability to make healthful change does not appear to affect participation in family health education programs. In addition, this study is important in that it shows that families will participate in health education or nutrition education programming originating in the classroom and requiring home and family involvement. Seventy-five percent of the families participated in the program, and of those participating, 36 percent completed more than half of the assigned home activities. This study also suggests that nutrition education originating in the classroom with a family component may affect parental consumption patterns.

While there are some important behavior changes reported using pre-post data, these changes must be cautiously interpreted. No control group is used as comparison, allowing numerous threats to internal validity. (A decision was made to include this article even though there was no control group. This decision was based on a judgment that the information gleaned regarding who participates in family programs, ethnic differences in participation, and information on the behavior change of children and adults was important to include.) The main trial of CATCH will examine changes in children's eating and exercise behavior, as well as physiological changes, using a randomized design and including 40 control and 56 intervention schools (Perry et al, 1992). CATCH is designed to

test the additional impact supplied by including a family component in addition to the school-only interventions.

Other weaknesses of the research include that only one adult in the family was interviewed (usually a female) and was asked to report on the family's and child's behavioral patterns. No follow-up of behavior change was conducted to test for maintenance of effects.

School-based studies-

2. Looking at program institutionalization

Devine et al.(1992) report on the effects of a nutrition education program disseminated to junior high school students in New York State. Nutrition for Life was the curriculum supported by the New York State Department of Education and disseminated to junior high teachers through 15 community-based peer training teams. At the time of impact evaluation it was determined that 50% of junior high school health, home, and career skills teachers and 75% of all teachers in the state who had received the program were using it. This study reports on knowledge, attitude, and behavior changes in schools identified as adopting or not adopting Nutrition for Life. As such, its design allows a glimpse at the effectiveness of a state-wide nutrition education program in a naturalistic, non-research setting.

The Nutrition for Life (NFL) program focuses on nutrition and food choices, nutritional needs over the life span, and nutrition and fitness, using an overall goal of promoting health and well-being. Classrooms to be evaluated were randomly chosen from lists of teachers reporting use of NFL and teachers reporting non-use of NFL. Seventy-five classrooms in each condition were matched according to community type, socioeconomic status of children in the schools, and teaching assignment of teacher. Following identification and teachers' consent to participate, teachers in the users group were sent surveys to administer to their classes with items included to assess knowledge, attitudes, and behavior. The non-users group received a shorter form including only attitude and behavioral questions. (Knowledge items were related to the content of NFL and were, therefore, not relevant to the non-users group.) Attitude measures related to learning about nutrition, effect of food choices on health, and value placed on nutrition. Behavioral measures asked students to indicate whether their intake of dairy foods, whole grains, fruits, vegetables, water, fatty foods, sweet foods, salty foods, diet foods, caffeine containing foods, and breakfast was less, more, or the same as compared to last year.

About 70% of the teachers returned usable test forms from 1863 students; response rate was slightly higher for users of NFL. Three types of classrooms were identified with the return of the surveys and subsequent analysis reflects three, rather than the intended two, groups. The three groups that emerged were: Users of NFL (NFL, n=35), Users of a nutrition education program other than NFL (TEACH, n= 37), and Non-users of any nutrition education (NO TEACH, n=26).

Significant differences in nutrition attitudes were seen between the NFL and TEACH and between NO TEACH and TEACH in home and career skills classes; those classes having nutrition education other than NFL had the lowest scores on nutrition attitude. A similar pattern was seen for the behavioral scores. No significant differences in nutrition knowledge were seen between the three groups for home and career skills classes. In health classes, significant differences were seen in nutrition knowledge and attitudes between the NFL classes and TEACH classes compared to the NO TEACH condition. No additional benefit was seen comparing NFL to TEACH classes. No significant differences in nutrition behavior were seen in health classes.

Students from schools with 10% or more students from families below poverty level showed greater increases in attitude and behavior change with higher exposure to NFL. An increase in exposure time from 2 hours to 5 hours resulted in improved attitude and behavior scores among lower-SES students.

The authors comment that the "real-world" application of NFL resulted in an average of three hours of program exposure for students; they note that the School Health Education Evaluation (Connell et al, 1985) found that moderate gains in knowledge, attitude, and behavior required 10, 35, and 45 hours of instruction, respectively. They suggest that differences in results between home and career classes and health classes might be explained by the fact that NFL influenced the health teachers to spend more time on nutrition while the home and career skills teachers were influenced to change the content of the nutrition curriculum they used.

This research showed that nutrition education taught in health classes resulted in improved knowledge and attitudes towards nutrition but no significant change in behavior. NFL was not shown to be superior to other nutrition education curricula in health classes. In home and career classes, nutrition attitude and behavior were highest in classes receiving NFL or receiving no nutrition education at all — a scenario that is hard to explain. Equally hard to explain is the lack of knowledge gain in any of the groups from the home or career classes.

The limitation of this research is the potential for response bias since only a small, self-selected sample of New York teachers participated in the survey. Scientific rigor is limited because of the purpose of the evaluation, which was to assess real-world application of a state-wide nutrition education curriculum. This article is very important because of its context, however. The ultimate goal of nutrition education must be to be effective, efficient, and feasible in practical application. The real impact of nutrition education must occur outside of the research arena and within the typical classroom setting.

Resnicow (1992)- This article further expands the accumulating literature evaluating the Know Your Body (KYB) comprehensive school health curriculum. This research is unique from other reported outcome studies of KYB in that the present study tracked children from grades 3-6 and the present study represents "real world" application of the KYB program; only one research staff project

coordinator was used to help implement the program in three intervention schools.

Five schools participated in the study; assignment to control or intervention condition was not random but was decided at the district level. Four of the schools were in the New York City/Bronx area and one school was in Houston, Texas and included primarily non-Caucasian children. These results look at a longitudinal cohort (student level outcomes available from students with measures at baseline and at Year 3 post-test) and a post-test-only cohort (made up of students with data available for Year 3).

The KYB intervention includes a classroom curriculum and school-wide activities (Resnicow et al, 1991). A health passport for each child was developed following risk factor screening. This passport was designed to make the child aware of their own risk factors and to provide motivation for behavioral changes taught and reinforced in the curriculum. The goal was to expose students to the curriculum for 30-45 minutes each week of the school year. A head teacher for each grade was designated whose responsibilities were to monitor and facilitate delivery of the curriculum. The research staff project coordinator conducted an initial half-day training and met with teachers twice yearly for consultation and support.

The school-wide activities included changes in the school cafeteria with goals of increasing the fiber content and decreasing the fat content of meals served. Also included in the school activities were peer leader training, student health committees, food tasting parties, poster and essay contests, and student aerobics.

Evaluation assessed physiological measures including: total cholesterol, body mass index, and blood pressure. In addition, health knowledge was assessed in all grades. In grades 4-6 only, health attitudes and self-efficacy scales were administered. Food frequencies were used in all grades, asking students to identify if they ate specific foods never, sometimes, or always. Students' responses to the food frequency questionnaire were summed to form six indices: dairy, meat, fruit, vegetable, high-fat, and heart-healthy foods.

Since this study was designed to test the "real-world" application of KYB, teacher effectiveness was determined to be important for evaluation and use in analyses. Based on evaluations from the project coordinator, teachers were classified as low, moderate, or high implementors. For the longitudinal analysis, students were classified as high, medium, or low exposure, based on having a moderate or high implementation teacher for two, one, or no years, respectively. For example, a student who had a teacher rated as a high implementor for their 4th- and 5th-grade years would be classified as having high exposure to the curriculum.

The longitudinal cohort included data from 2973 students at baseline and 1209 students (41%) at follow-up. The high attrition rate was attributed to outmigration from the school, lack of parental consent, and absenteeism. The

longitudinal cohort was primarily Hispanic (60%), with 23% Black, 11% White, and 5% Other. At the 3-year post-test, students in the high exposure group had significantly lower total cholesterol and systolic blood pressure compared to the control group. No significant differences were seen between the high exposure group and the comparison group for BMI or six dietary indices. Knowledge was significantly higher in the control group as compared to the high exposure intervention group. When all the intervention groups (high, medium, and low exposure) were combined as one treatment group for comparison to the control group, the intervention group had significantly lower total cholesterol, systolic blood pressure, and health knowledge and significantly lower intake of dairy and desserts.

The post-test-only cohort was made up of 3146 students completing questionnaires and/or screening data at Year 3 and had an ethnic breakdown similar to the longitudinal cohort. Students with a high-implementation teacher during Year 3 had significantly lower total cholesterol and systolic blood pressure and higher health knowledge scores as compared to students in the control group. Higher intakes of vegetables and heart-healthy foods and lower consumption of meat and desserts were also evident in intervention students with a high-implementation teacher. Combining all intervention students and comparing them as a group with control students, they showed significantly lower systolic blood pressure and higher health knowledge than the control group. They also reported significantly lower intake of desserts and greater intake of vegetables and heart-healthy foods.

The authors carefully point out the limitations of the study, including non-random assignment to treatment condition, high attrition rate in the longitudinal cohort, potential instrumentation problems leading to mixed results with the knowledge and attitude measures, and the use of a non-quantifiable dietary assessment measure.

This study allows for studying the effects of a comprehensive health education program including a nutrition component in a more naturalized setting. The study showed significant decreases in important physiological measures and mixed results in behavioral and knowledge indices. No significant findings were found with respect to BMI, self-efficacy, or health attitudes. The naturalistic nature of the study, with attention paid to level of implementation by teachers, shows that only 12% of the longitudinal cohort had the advantage of having a high-implementation teacher for at least two years of the study. The results, broken down by implementation level, show that greater implementation has positive physiological and behavioral effects. The authors conclude that, at the very least, classroom teacher implementation of health curricula needs to be carefully monitored and enhanced, or alternatively, health educators may need to be hired to teach or coordinate health education in the schools in order to have effective programs.

School-based studies -

3. *With a community component*

Kelder et al. (1995)- This research is one of the few studies to examine the effect of nutrition education occurring in the classroom and in the community in a cohort of students throughout their junior and senior high years. The Class of 89 study was part of the larger Minnesota Heart Health Project (MHHP) (Blackburn et al, 1984) and followed a cohort of students, randomized by community into control and intervention conditions, from 6th through 12th grade. The intervention community was Fargo-Moorhead, in North Dakota and Minnesota, and the control community was Sioux Falls, South Dakota.

As part of the community intervention, students were potentially exposed to health behavior messages in the media regarding heart-healthy eating, exercise, and smoking prevention or cessation. In addition, community screening for heart disease, labeling of heart-healthy restaurant options and grocery store items, and other adult and professional education campaigns occurred in the intervention community. In the schools, two nutrition education programs occurred: Lunch Bag in the 6th grade and Slice of Life in 10th grade. Lunch Bag was a brief one-hour session introducing the components of a heart-healthy diet and how to build a healthy lunch. In addition, students received recipe books with healthy snacks and food lists, and wrote their own newspaper column entitled "Getting Ready for the 21st Century," which encourages the intentions of eating a healthy diet and increases the value of personal health.

Slice of Life was a 10-session, peer-led curriculum designed to promote healthy eating and increase activity levels (Perry et al, 1987). Slice of Life is based on Social Learning Theory and Decision Making Theory and attempted to increase knowledge about nutrition and physical activity, increase awareness of environmental influences of health behavior, raise the value of health, and provide experiences to increase internal locus of control.

Effects of the intervention were examined by comparing control and intervention condition responses on a self-report survey administered in April of each school year from 6-12th grade. Food behavior was assessed by asking students to identify which food, in each of 18 food pairs, they would "...usually eat when they had the choice." The range of the scale was from 0-18, where a score of 18 indicated that the student chose the healthier option for all pairs. In addition, the same 18 pairs of food were used to assess knowledge with students asked to identify which food in each of the 18 pairs, "...you think is better for your health." Again, a range of 0-18 was possible, with 18 identifying a 'perfect' score. Finally, a food salting behavioral measure was evaluated, asking students if they add salt to foods before tasting them and if they use the salt shaker when they eat dinner at home.

Analysis was conducted looking at differences between baseline and each annual examination, allowing cohort differences to be assessed. Covariance adjustments were made for baseline values of the dependent variables (knowledge and behavior) and age, gender, and, when available, parental job

class. In addition, correlational analyses were run between knowledge and behavioral variables, adjusting for age, gender, and intervention condition, including cross-sectional samples of students. Current knowledge and food choice behavior were also used to predict food choice behavior in the subsequent year (e.g., knowledge and behavior at 7th grade were used to predict behavior in 8th grade).

Results show that females in the intervention condition reported healthier food choices as compared to females in the control group in all but the 12th-grade year. Males in the intervention group reported healthier food choices than males in the control group in all but Grade 11 and Grade 12. Significantly less salting behavior was seen in the intervention condition for males and females and significant gains in knowledge were seen in males and females in the intervention condition for every year except for males in the 8th grade.

The analysis looking at the relationship between knowledge and food choice scores at each year shows variance in behavior explained by knowledge to range from 4-7 percent of variance explained. While the associations are statistically significant, significance is probably due to the large sample size ($n = 1070-2376$). The analysis conducted to examine knowledge and behavior at one year predicting behavior at the following year resulted in the finding that behavior from the previous year was a much stronger predictor of current food choice behavior than were previous year's knowledge scores (i.e., in the 6th grade, beta coefficients for knowledge and behavior were .05 and .51, respectively).

The limitations of this study include the measure of food choice behavior, which was not designed to examine total dietary behavior but rather food choices between pairs of options. Time and financial constraints prohibited more accurate assessment of eating behavior. Pilot work, however, did show the scales to have test-retest reliability correlations of .59-.63. Attrition also reached 45 percent by Grade 12; attrition analysis showed that food choice and salt scores for the year previous to dropout tended to be lower for missing students, but did not reach statistical significance. Another weakness of the study is that the effect of the community health promotion campaign cannot be separated out from the classroom effects since a factorial design was not used. Generalizability of the results is limited to middle-class, predominantly White populations.

This study shows that community and classroom interventions can significantly influence students' self-reporting of food choice behaviors and nutrition knowledge. The significant effects were noted in almost all seven years of the study using a cohort design. The importance of community-based messages regarding heart-healthy behaviors on impacting behaviors of children and adolescents is demonstrated. In addition, this study is one of the few that looks at the relationship between knowledge and self-reported behavior, demonstrating that the relationship between knowledge and behavior is small. This finding highlights the importance of nutrition education that stresses behavioral change as opposed to knowledge change alone. In addition, this finding dispels some of the fear of reporting bias caused by social desirability. If

response bias were occurring to a large extent, the relationship between knowledge and food choice scores would have been larger, especially since the exact same set of 18 food pairs was used to measure both knowledge and behavior.

School based studies-

4. Using computer systems

Burnett et al.(1989)- This study compares two school-based health promotion interventions for high school students with a control group using a pre-post design. Three schools were randomly assigned to a condition and a limited number of students in each school participated in the study. The computer-assisted, health tip sheets, and assessment-only conditions had 45, 17, and 15 students participate, respectively.

A student health behavior survey (SHBS) was the primary evaluation tool, administered to students in all conditions five times over a period of 12 weeks. The SHBS asked students to describe their dietary behavior over the last week with emphasis on saturated fat, cholesterol, fiber, and complex carbohydrates. A saturated fat and cholesterol index and a fiber and complex carbohydrate index were formed. Acceptable test-retest correlations were obtained in a pilot phase. In addition to the SHBS, students weighed themselves weekly using a defined study protocol and recorded their weights. This assessment was done to determine the intervention's effect on weight loss or gain in students identified as being over- or under-weight.

Two intervention techniques were evaluated: a computer-assisted feedback condition and a health tips condition.

Computer-assisted: Students completed the Student Health Behavior Survey (SHBS) at baseline and received a packet of 14 health tip sheets including information on consumption of meat, cheese, eggs, cream, milk, chicken, fish, fruit, vegetables, legumes, bread, shortening, and fat. They then received a computer-generated feedback letter regarding their health behaviors using the SHBS results. Three additional SHBS's and feedback letters were given and specific health tip sheets relating to problem areas. A final SHBS served as a final assessment.

Health tip sheets: Another group received the SHBS five times and health tip sheets at baseline without feedback on their SHBS results.

Assessment only: The SHBS was administered 5 times with no feedback and no health tip sheets.

Results from the SHBS show that students in computer-assisted feedback condition reported significantly improved scores in both the saturated fat and cholesterol intake index and the fiber and complex carbohydrate index. For those students identified as 10% above ideal weight, the computer-generated feedback condition resulted in significant change in self-reported weight (mean

loss = 6.5 lbs). No significant changes across conditions were seen for those students who were 10% under ideal weight.

Significant improvements in the saturated fat and cholesterol intake index were also seen in the assessment only group. The health tip group saw no positive significant change in either index pre to post. In fact, a significant change in the less healthful direction was seen for the saturated fat and cholesterol index.

Some of the weaknesses of the study include: 1) small sample size; since schools were randomized, the unit of analysis is actually the school, making the sample size three, 2) assessment of eating behavior is limited to changes in the two indexes although other food behaviors were targeted by the health tip sheets, and 3) there is no follow-up assessment to see if students maintain eating changes. The mixed results (assessment only showing significant changes in saturated fat and cholesterol index, and the Health Tips group showing change in the wrong direction for fiber) are difficult to explain.

School-based studies-

5. Knowledge based

German et al. (1981)- This article describes the evaluation of a nutrition education curriculum for high school students, featuring nutrient density as an important nutrition concept. Two high schools in Utah served as research sites; one class in each school served as a control group while the other class received a nutrition education unit as part of their health curriculum. A pre-post design was used to measure change in nutrition knowledge and attitudes about nutrition education. Students also completed a Food Frequency Indicator before and after the intervention to measure changes in eating behavior. Ninety-two students in the intervention group and 45 students in the control group completed pre- and post-tests.

Little information is given regarding the content of the intervention. Ten sequential lesson plans were provided and three main topic areas were covered: nutrient needs, qualitative evaluation of foods using the nutrient density concept, and energy balance and weight control.

Results showed a significant gain in knowledge for the intervention group relative to the control group; however, no significant differences were seen in the Food Frequency Indicator between treatment groups. Attitudes toward nutrition education were slightly more positive on the post-test, although significance testing between groups is not reported.

This research indicates that knowledge gains are possible with nutrition education taught as part of a health curriculum to senior high students. Unfortunately, behavioral change was not detected and durability of knowledge increases was not evaluated. The study is limited because of its limited sample size, lack of follow-up, and limited generalizability due to its testing only in Utah schools.

Green et al. (1991)- This study reports on a nutrition education program designed to increase female high school students' knowledge of calcium balance and its importance. Sixty-four 14-16-year-old girls were randomly assigned to intervention or control conditions using their physical education class as the sampling frame. The intervention group met for three days to receive a nutrition education unit focusing on the role of calcium, sources of calcium, requirements for calcium, and diet and disease relationships.

The effectiveness of the intervention was tested using a nutrition test, lifestyle questionnaire, and 24-hour recall administered pre-and post-intervention and at one-month follow-up.

The program resulted in significantly higher knowledge scores at post-test and follow-up for the intervention group. No significant differences in the calcium or Vitamin D intake were observed between treatment groups across both post-test periods.

This study tests the effectiveness of a targeted nutrition education program geared towards increasing calcium intake in female adolescents. Knowledge differences, but not behavioral differences, were seen between treatment groups. There are some important limitations to this study. Randomizing girls within classes could lead to contamination of treatment conditions. In addition, the sample size was quite small.

School-based studies

6. Studies of other school and classroom-based nutrition education

King et al. (1988) report the effectiveness of a three-week, five-session (50 minutes each) nutrition education curriculum designed for 10th-grade students. The majority of the students were Caucasian, with some representation from Asian and Hispanic students. Twelve classrooms in two schools were randomized into treatment and control conditions. The treatment classes received a curriculum taught by a health professional who was part of the research staff; classroom teachers were present during the curriculum presentation.

While no theoretical model was named in guiding the intervention, the authors indicate that the curriculum was designed to "...provide students with dietary information and a variety of cognitive-behavioral strategies for modifying dietary practices" (p. 69). The content of the curriculum included: separating food facts from food myths, making choices regarding health behaviors, self-assessment of dietary patterns, problem-solving approaches for changing health habits, goal setting, and behavioral rehearsal and skill-building exercises. Evaluation of the program included a self-report measure and a behavioral assessment examining snack choices. The self-report measures included a 20-minute, paper-pencil test assessing knowledge, food frequency, attitude, self-efficacy, behavioral intentions, and home availability of healthful foods. This assessment was conducted pre- and post-intervention and at a one-year follow-up. The behavioral assessment involved offering students a choice of snacks as

a thank-you for participating in the self-report assessment; two heart-healthy snacks and two snack items high in saturated fat, sugar, or sodium were offered. Students' choices were recorded. In addition, students received coupons for snacks offered in the school lunchroom. Students were required to indicate which snack they intended to choose with the coupon. This assessment was conducted pre- and post-intervention only.

Pre-and post-data were available on about 50% (n=218) of the students due to high absentee rates. No differences in attrition by treatment condition were seen. The results showed that significant increases in knowledge, reported healthful dietary behaviors, and reported availability of healthful foods at home were evident in the intervention classrooms as compared to the control classrooms. Significant predictors of positive healthful dietary behaviors (accounting for 14 percent of the variance) were: positive change in reported availability in the home, positive changes in knowledge, and positive changes in attitude. There were no significant differences in attitudes, behavioral intentions, or self-efficacy.

The post-intervention behavioral assessment of observed snack choices showed no significant differences between treatment groups. While significant differences were seen in intended snack choices via coupon, the sample size for students participating in this assessment is small (n=50), limiting interpretation of the results.

At the one-year follow up, 211 students in control and intervention classrooms (representing a cross-sectional sample) completed the self-report measures. Significant differences in knowledge were seen between the treatment groups; no other significant differences between groups were seen. In addition, results from the cohort sample (those students with both pre-program and follow-up data) were investigated. Again, significant differences in knowledge were evident between treatment groups.

This research showed positive changes in dietary knowledge and self-reported dietary behavior following a five-week behaviorally based nutrition education curriculum. Knowledge gains were maintained at one-year follow-up. In addition, analysis of the self-report data indicated that home availability and changes in knowledge and attitudes were significant predictors of self-reported dietary behaviors. The description of the intervention gave no information on how home availability was targeted via the intervention. However, the authors suggest that adolescents can be influential in determining family food choices, suggesting that the intervention attempted to involve the adolescents directly in home food-related decisions. The authors note that diet-related behavior change was affected without significant changes occurring in attitudes, supporting a behaviorally centered approach to nutrition education.

There are some important limitations of this study. The most obvious is the high attrition rate; pre and post data were available on only 50% of the students. In addition, control and intervention classes were mixed within schools, leading to possible contamination between conditions. In addition, overall

sample size was limited, particularly in the coupon-related snack choice measure. A university-based staff member delivered the intervention, limiting generalizability of effectiveness with more traditional, teacher-led nutrition education models.

Arbeit et al. (1992) report on physiological, behavioral, and knowledge changes following exposure to the Heart Smart Program, a school-based health promotion designed to affect cardiovascular risk factors. The program included a classroom curriculum for K-6th grades based on social cognitive theory, emphasizing healthful eating habits, exercise, self-esteem, self-care, and healthful lifestyles learned through behavioral skills. The curriculum was delivered between 15-35 hr/year for K-6th grades. In addition, Heart Smart also included cardiovascular screening, changes in school lunch, changes in physical education, a parent outreach for all students, and a family health promotion program for families with children at high risk for CVD.

The study reported that significantly higher levels of HDL were seen from pre- to post-intervention in students in the intervention schools as compared to those in the control schools (n=142, 4th- and 5th-grade students); the authors did not report on differences between control and intervention groups in total cholesterol, blood pressure, or ponderosity. Students in the intervention schools did not show significant differences in growth (measured by height and weight) as compared to growth rates in the control schools.

Changes in behavior were assessed by comparing physiological data on 136 5th-graders with their selection of CV-healthful or regular school lunch. No data were presented on the differences in choices between control and intervention schools. The authors do report that children with the greatest cholesterol reduction and greatest reduction in ponderosity had the largest number of CV-healthful food choices. There was no significant difference in increase in CV knowledge between the intervention and control schools. However, in the intervention schools, where the Heart Smart curriculum and exercise components were administered, 4th-grade participants showed significantly greater gains in knowledge scores than did nonparticipants.

It is difficult to assess the effectiveness of this intervention because of the way the data are presented. Very few data are presented showing differences between control and intervention schools. The data that are presented indicate that the intervention group experienced a gain in HDL levels, as compared to the control group, but no significant gain in CV knowledge. There are no data presented on behavioral differences between the control and intervention groups. Even the school lunch modification does not present pre-post data. It is reported that the CV-healthful lunch choices contained less sodium, saturated fat, and sugar than the usual menu, suggesting that the modifications were feasible but saying little about their effectiveness. In addition to data presentation, this study suffers from small numbers, from self-selection of children into parts of the evaluation, and from only looking at changes in the 4th and 5th graders while the intervention occurred in K-6th grades. In addition, no attempt to measure

exposure to program components was made. Response bias, with 59-62% of the eligible 4th and 5th graders participating in CV screening, is also a concern.

Domel et al. (1993) report on a nutrition education intervention to increase school children's consumption of fruits and vegetables. Fourth and fifth graders in a Georgia public school were exposed to the Gimme 5 curriculum (based on SCT), a social marketing approach designed to enhance students' abilities to ask for and prepare fruits and vegetables. The curriculum included taste-testing, recipe preparation, goal-setting, self-monitoring, and problem solving, using goal buddies to promote social support. Fruit and vegetable consumption was assessed by having children complete food diaries for two weeks before and after the intervention. In addition, validation of the self-reports occurred during school lunch, although the authors do not report on the results of the validation. Changes in knowledge and preference surrounding fruits and vegetables were also assessed.

Results show that overall fruit and vegetable consumption was not significantly affected by the intervention. Fruit consumption was significantly greater in the intervention school as compared to the control school. However, even at post-test, students were eating, on average, less than 1 serving of fruit/day and most of the increase in fruit consumption occurred at school lunch. Significant gains in knowledge and in increased preferences for fruits, and fruit and vegetable snacks, were achieved in the intervention school. However, increased preferences for vegetables were not seen. The authors suggest that more intensive intervention efforts are needed, including greater effort in the curriculum and school food service as well as greater community and parental involvement.

Killen et al. (1993) describe the implementation and evaluation of the first long-term, controlled study testing the effectiveness of a school-based curriculum to modify unhealthful eating practices and weight regulation practices of 6th- and 7th-grade girls.

A total of 967 6th- and 7th-grade girls from four California schools were randomized into treatment or control conditions, stratified by grade and class. The prevention intervention consisted of 18 lessons built on three principal components: instruction on the harmful effects of unhealthful weight regulation, promotion of healthful weight regulation through healthful nutrition and activity patterns, and development of coping skills to counter sociocultural influences on excessive dieting and unrealistic body image. The program was delivered via slide show using scenarios depicting adolescent girls to highlight program objectives. A workbook with homework lessons was also provided.

The curriculum was evaluated by taking anthropometric measures (height, weight, body mass index) at baseline, 18 weeks, 7 months, 14 months and 24 months. In addition, knowledge, eating restraint, self-reported unhealthful eating practices and weight regulation, and an eating disorder inventory were administered at baseline and at at least one other measurement period. Analysis was conducted looking for differences in treatment groups across time and, in

addition, differences in high-risk groups. A high-risk group was identified based on their scores on the Weight Concerns scale and were those girls who were more likely to have tried self-induced vomiting, laxatives, diet pills, and alcohol in the last month or to have depressive symptoms.

Results of the study show that the intervention produced significantly improved knowledge scores in the treatment group as compared to the control group, but no other intervention effects are shown. A small but significant effect on BMI was found in the high risk group.

The authors conclude that a prevention intervention for 6th- and 7th- grade girls is not warranted; the prevalence of eating disorders is small and relatively stable in a population. They suggest that such interventions may be considered for at-risk girls, although they include the caveat that a prevention intervention for at-risk girls may need to be more intensive than the one that they tested and may best be linked with treatment resources.

The study might have been strengthened by evaluating changes in eating behavior pre- and post-intervention. In addition, the age-appropriateness of the intervention should be considered. In particular, was the curriculum message understandable to the subjects?

Resnicow, 1993- School-site cardiovascular risk factor screening (cholesterol, blood pressure, height/weight, and physical fitness) in combination with the Michigan Model Comprehensive School Education (MMCSE) Program was evaluated for its effect on knowledge, attitudes, and behavior of children and their parents.

Children in eight Michigan public schools (grades 1-6) participated in the one-year study. Four schools were chosen by their school district to receive the screening program in addition to the MMCSE and were paired with four district schools who would receive the MMCSE without the screening program. The screening program included three classroom sessions prior to and following the screening, delivered by classroom teachers and based on the Know Your Body Health Profile program. Activity books were designed for grades 1-2, 3-4, and 5-6 and were designed to be integrated into the MMCSE. Little information is given on the content of the MMCSE except that it is modeled after the Growing Healthy curriculum.

Questionnaires to assess knowledge, attitudes, and behaviors were administered to students in both treatment conditions at baseline, prior to the first of two available screening periods during the school year, and at one-year post-test. The student questionnaires were to assess health knowledge, perceived severity and susceptibility to heart disease, nutrition attitude, locus of control, and perceived costs and benefits of risk factor screening (variables from the Health Belief Model (Rosenstock, 1990). In addition, in grades 1-2 a nutrition awareness scale was included and in grades 3-6 attitude scales were administered to tap health locus of control, importance of health screening, and confidence in nutrition knowledge. All grades completed a nonquantitative food

frequency asking students how often they consumed indicator foods chosen by virtue of their fat, cholesterol, sugar, and fiber composition.

Parents completed questionnaires at baseline and one-year follow-up on nutrition knowledge, use of medical services, attitudes, and family eating patterns.

At baseline, 95% percent of students and 89% of parents completed questionnaires. At the one-year follow-up, 64% of those participating in baseline questionnaire completed the second questionnaire; 38% of baseline parents completed a second questionnaire. Eighty-nine percent and 81% of students participated in the first and second screenings, respectively. Significant treatment differences between baseline and the one-year follow-up questionnaires were seen for health knowledge, nutrition awareness, and locus of control. Those students who had participated in screening also reported a lower consumption of high-fat foods and more frequent exercise. Students participating in screening were also more likely to respond favorably to items relating to salience and importance of health and health screenings. Parents completing both surveys showed significant treatment differences for health knowledge, benefits of health screening, confidence in nutrition knowledge, importance of low fat and high fiber foods, change in child's health habits, and satisfaction with health education in their child's school. No treatment effect was seen for parents' perception that their child had become too concerned about his/her health.

In order to determine if the effects noted were due to participation in screening or to the classroom activities related to the screening program, analysis was run comparing those students who did not participate in screening (n=80) with those students who did participate in at least one screening (n=1499). Treatment effects were seen only for those students who participated in the screening. Also, analysis was conducted to see which, if any, of the attitudinal variables assessed were predictive of self-reported behavior change; none of the health belief model variables nor locus of control was found to explain behavior change.

The authors clearly outline the limitations of the study including: non-randomized schools and high attrition rate between baseline and one-year follow-up surveys, limiting external validity; use of non-quantified food frequency to assess dietary behavior; and control schools which, in fact, were delivering some nutrition education.

This study is interesting in that positive results were found when cardiovascular risk screening occurred in schools. The authors estimated that the cost of screening was \$6 - \$10 per child. Risk factor screening stands out as tangible evidence that schools are attuned to health concerns and may act to increase public relations with parents and families in a way that completed homework or report card grades may not.

B. Outside of school-based studies-

1. Targeting families

Baranowski et al. (1990)- This study reports on a family-based intervention to promote lower fat, saturated fat, and sodium intake in Black-American families. Families which included at least one child in grades 5-7 were recruited for participation in the study. Following recruitment, 96 families were randomized into a control or intervention condition.

Fourteen weekly sessions were conducted during the evening in the library of a high school. The program was designed to provide individual family counseling for dietary behavior change, with intervention strategies drawn from social learning theory, social support, and adult education. Educational experiences were offered to children and parents separately. In addition to the didactic educational component of the program, aerobic activities and healthful snacks were important components of the weekly sessions.

The effectiveness of the program was evaluated via food frequencies and 24-hour recalls administered pre-and post-treatment to adults and children independently. In addition, measures of behavioral capacity and self-efficacy were administered pre- and post-intervention.

One of the most notable results was the high dropout rate. Seventeen percent of the intervention families attended more than half of the sessions while 43 percent attended none of the sessions. Forty percent attended less than half of the sessions. Children's participation rates were similar at 19, 34, and 47 percent attending more than half, none, and less than half of the sessions, respectively. Using the food frequency, significant effects are seen in consumption of high total fat foods, high saturated fat foods, high sodium foods, high polyunsaturated fat foods, and high calcium foods. The trends in the high polyunsaturated fat foods and high calcium foods are in the unfavorable direction of decreased consumption. Analysis of dietary changes using the 24-hour recall showed no significant treatment effects except for sodium intake by boys. No significant effects were seen for behavioral capability nor self-efficacy except that adult groups scored higher than children's groups on behavioral capability.

The primary limitation of this study is the very high attrition rate, limiting generalizability of results. The difficulty of getting families to come to an evening health promotion program is clearly brought to light and speaks to the realities of time commitment, perceived barriers, and limited perceived benefits of such programming. While the majority of participants said they attempted to make changes in the amount of sodium and saturated fat in their diets, they cited such barriers as: not wanting to give up the foods they like, loss of taste with reduced sodium, inability to control fat and sodium of meals outside the home, family members complaining about changes in diet, not knowing which foods were high in fat, and not wanting to spend the time to read labels. In addition, the research study demanded randomization into control groups; some participants noted that relatives or friends randomized into the control group eliminated one of the social reasons to participate in the study.

Wagner et al. (1992)- This article reported on a family-based study which was imbedded in a larger study, Nutrition for a Lifetime Study 1 (NLS 1). NLS 1 was designed to influence consumers to alter their grocery shopping behavior to comply with recommendations from the National Cancer Institute (e.g., purchase fewer higher-fat foods and purchase more high-fiber foods) and involved 77 participants randomly assigned to a control or intervention group. The intervention condition received weekly nutrition education programs via video, feedback on their intended food purchases, and help with setting goals toward meeting NCI recommendations. Those participants in the family study (NLS 2) had children between the ages of 8-16 and agreed to participate in the ancillary study. Assignment into treatment group was based on their assignment for NLS 1. The intervention group received the NLS 1 intervention plus optional, additional nutrition education information (e.g., how to read a food label) via interactive computer and more specific feedback and goal setting information for individualized fat and fiber goals. Parents viewed a different nutrition education video disc program (2-8 minutes in length) for five or six weeks which offered suggestions regarding children's food choices; children did not directly interact with NLS 2. Topics for the video involved: simple goal setting related to food purchasing and preparation, strategies to overcome problems with meeting goals, meal preparation for children, snacks for children, maintenance strategies, and long-term commitment to change.

Behavior, preference, and knowledge were assessed by asking parents and children independently to complete card sorting tasks (CST) which asked them to identify what they *do* eat, what they would *like to* eat, and what they think they *should* eat. A Food History Questionnaire (FHQ) was also administered to children and adults independently to determine information about their usual diet. Pre- and post-interviews were conducted with control and intervention groups. Neither reliability nor validity assessments on these measures were provided.

The results showed a significant difference between control and intervention children for snack preference. Trends for change in the desired direction were also reported for children's snack and entree choice behavior and knowledge gain. While there were not significant differences between treatment groups for children based on FHQ scores, trends were noted for intention to increase low-fat dairy and high-fiber grain consumption. The authors report that child and adult food consumption changes were significantly correlated at .54 for fruit consumption; however, correlations for other food consumption changes were not discussed.

This study investigates the impact parents can have on children's food preference, behavior, and knowledge when the parents receive training on nutrition education. The nutrition education message was delivered via interactive video and was individualized using information obtained via grocery shopping. The results show a few statistically significant effects and more trends in the correct direction. Failure to detect more positive effects could have been due to the small sample size. While there are other weaknesses in the study, particularly lack of validity or reliability assessments of measurements used, this

study presents an innovative and important approach to nutrition education for children. While most nutrition education for children occurs in a school setting, few would deny the strong family influence on children's eating behavior. This intervention model allows families to learn about nutrition using an interactive, innovative, and individualized approach, and provides an important nutrition education link between adult and child family members.

Outside of school nutrition education-

2. Knowledge-based programs

Connor et al. (1986)- This study describes a cardiovascular health education and fitness program for 3rd- and 4th-grade students administered in an after-school day care setting. Four after-school programs in San Francisco were randomized into control or intervention conditions. Of the students participating in the program (n=55) 44 percent were Black, 44 percent were Hispanic, 7 percent were White, and 5 percent were of other ethnic descent.

The Heart Health Education Program involved two 30-minute sessions over 12 weeks and was taught by school teachers trained in delivering the intervention. Content areas of curriculum instruction included: anatomy and physiology of the cardiovascular system, attitude and decision making, risk factors and prevention of heart disease, exercise physiology, heart healthy nutrition, smoking, handling stress, and response to emergency situations. An aerobic exercise program consisting of three 45-minute sessions each week was also included.

Effectiveness of the program was evaluated by pre- and post-intervention administration of a knowledge survey (cardiovascular system and healthy lifestyles) and attitude survey (tapping attitudes toward taking care of their bodies) and by heart rate monitoring of two selected children at each exercise session.

Results show that the intervention had significant effects on knowledge gain. No significant change in attitude occurred between control and intervention groups. As a group, heart rates were not satisfactorily maintained within the target zone.

The weaknesses of this study include the small sample, lack of follow-up measures, and the lack of a behavioral assessment. The assessment of fitness, heart rate, was not conducted on all children but on a sample of two at each measurement period and the protocol for taking heart rates appeared to be poorly defined and implemented.

In spite of the weaknesses of this study, the authors do offer some interesting insights into implementation of a health curriculum in an after-school setting. While the idea sounds intuitively appealing as more children spend increasing hours in after-school childcare, the authors indicate that children were not anxious to give up unstructured play time to participate in another curriculum, led by teachers, which included "tests" (the knowledge and attitude surveys). In

addition, regular attendance in after-school childcare was not a given; some children attended sporadically, leading to difficulty in continuity of lessons from one day to the next. If nutrition education is to be used in after school programs, it will need to be designed as a child-centered fun activity that can be picked up for short and disjointed periods of time without jeopardizing effectiveness.

Anliker et al. (1993)- This study reports on nutrition knowledge gain achieved by teenagers teaching younger children about nutrition. The nutrition education took place as part of the New Haven Summer Youth Nutrition Education Program, a cooperative program incorporating efforts from New Haven EFNEP, the Connecticut Summer Food Service Program, and the Private Industry Council.

School teachers received training from Cooperative Extension State Nutritionists to teach nutrition curriculum to teens, who then taught younger children as part of a summer nutrition education program. The curriculum included objectives, handouts, and suggested activities and had as its primary goal to increase nutrition knowledge of food groups and functions of nutrients. Five sessions were included.

This study examined knowledge gain for those teenagers functioning as teachers; knowledge gain of the younger children was not assessed. A pre and post knowledge test was given to 30 teenagers involved in teaching the nutrition curriculum (treatment group) and 19 teenagers working with young children in the program in non-nutrition related topics (control group). Pre and post data were available in 27 treatment and 13 control subjects. The intervention group showed a significant increase in knowledge scores as compared to the control condition. Significant gains were seen in all the subscales (food sources of nutrients, balanced lunch menu, recommended servings from food groups, nutrient functions, and true-false statements) except lower-calorie food substitutions.

This research shows that teenagers trained to teach a nutrition curriculum to children outside of a school-based program can achieve significant knowledge gains. This concept of peer-led nutrition education needs to be further explored. Other behavior change programs for children and adolescents (e.g., smoking, drinking, and drug use) have successfully used peer-led education (Klepp et al, 1986; Perry et al, 1988). Unfortunately, this research did not answer several important questions such as: Did the knowledge level of the younger children change as a result of the curriculum? Were knowledge change effects maintained? Was behavior of the teen teachers or the children affected by the intervention? In addition, the research is limited by small sample size and the lack of a behavioral approach in the curriculum.

IV. SUMMARY OF FINDINGS

Of the 17 articles reviewed, 11 were published since the reviews by Lytle Trenkner et al. (1991) and Contento et al. (1992). Five of these articles expanded on previous work or reported on follow-up results or diffusion of

previous work. Tables 1- 3 summarize the intervention methods (Table 1), the evaluation methods (Table 2) and the results of the articles (Table 3).

Looking first at the intervention aspects, half (53%) of the articles (both in total and since 1991) did not mention a theory used in the development of the intervention. All of the articles citing a theory indicated that social learning or social cognitive theories provided the conceptual framework for the intervention plans; the PRECEDE model was mentioned by one study. Six of the 17 appear to have a knowledge rather than a behavioral focus (German, 1981; Burnett, 1989; Devine, 1992; Anliker, 1993; Killen, 1993; and Green, 1991); most of these programs were targeted at junior or senior high school students. Four (Luepker, 1988; Hearn 1992; Baranowski, 1990; and Wagner, 1992) included a family component. Two of the studies use risk factor screening as part of the intervention (Resnicow, 1993; Arbeit, 1992) possibly influencing families indirectly through providing results of children's risk status. The dose of the interventions vary considerably from a median of three hours (Devine, 1992) to weekly for the entire school year for more than two school years (Resnicow, 1992). Those articles reporting number of sessions included in the intervention indicate a range of six to thirty-six sessions with a mean of 12.6 sessions per intervention. Time spent on sessions range from two minutes (Wagner, 1992) to 90 minutes (Baranowski, 1990). Looking at only those interventions delivered within schools, the range is from 30-50 minutes per session.

The majority of the interventions were delivered in the classroom (59%) and by classroom teachers (53%). When training was provided to teachers (59%) it typically was accomplished via inservices. Forty-seven percent of the studies were federally funded, 18% were state funded and the remainder were funded from research foundations, food companies or the American Heart Association.

Table 2 summarizes evaluation aspects of the studies. The criteria used in selecting articles dictated that only studies with control groups would be included. (This author suspended that criteria for one article, Hearn, 1992). Half of those studies with a control group used random assignment into treatment conditions and 19% included a follow-up measure beyond the post-intervention measure (King, 1988; Resnicow, 1992; Kelder et al. 1994). Samples were typically drawn from within one state although 25% tested the intervention in more than one state. Fifty-six percent of the studies included at least a 20% non-Caucasian sample. While the number of schools involved in each intervention was fairly limited (range= 2-31 schools), there was a wide range in the number of individuals measured across the studies (range= 24 families- 3045 students.) Eighty-two and 59 percent of the studies assessed knowledge and attitude change, respectively, and 82 percent assessed behavioral change in a multitude of ways. Physiological outcomes ranging from weight to LDL cholesterol were assessed in 29 percent of the studies. Three of the articles (18%) reported that their behavioral measure had been validated while 53% reported some reliability assessment of knowledge, attitude, or behavioral measures.

Table 3 highlights study outcomes. Seventy-one percent of those studies reporting on knowledge outcomes showed significant gains in knowledge for the intervention condition in relation to the control group. Fifteen percent showed mixed results and 14 percent showed greater knowledge gains in the control relative to the intervention condition. Sixty percent of those studies assessing attitudes saw no significant differences between treatment groups; 30 percent saw significant differences and 10 percent showed mixed results. Behavioral outcomes were mixed within studies. Virtually no study was able to show positive outcomes on all behavioral measures assessed, however two-thirds of the studies reporting behavioral change between treatment conditions reported some significant differences. One-third reported no significant differences between control and intervention conditions. Of those five studies reporting physiological outcomes, three reported no significant differences between treatment groups while two (Arbeit, 1992; Resnicow, 1992) reported mixed results with some significant improvement being made in intervention compared to control schools.

V. DISCUSSION- ADVANCES SINCE THE LAST REVIEW

A. Gains in nutrition education for school-aged children.

1. Focus on behavior change

Some important gains have been made in nutrition education. Past reviews and commentaries have called for nutrition education to focus on behavioral change. Of the 17 articles reviewed, 14 had a behavioral outcome measure and 11 indicated that their curriculum was behaviorally-based. Two articles (Anliker et al. 1993 and Green et al. 1992) still focused on nutrition knowledge gain through both program content and evaluation measures. It is well established in the nutrition education literature that a nutrition education program can result in significant knowledge gain. (This review, however, revealed several programs that did not result in consistent nutrition knowledge gains (Devine et al. and Resnicow et al.) It is difficult to say whether the lack of knowledge effects were due to weaknesses in the intervention or in measurement of knowledge change.)

a. Rationale for behaviorally-based programs

The rationale for the move from knowledge-based to behaviorally-based programs rests on accumulated evidence in the scientific and behavioral fields. The scientific field has shown ever-increasing links between diet and chronic disease. Cardiovascular disease will be used as an example. First, cardiovascular risk factors are evident in young people (Enos et al. 1955; Strausser et al. 1980). Evidence of cardiovascular disease was present in soldiers (men in their early 20s) killed in the Korean and Vietnam wars. In addition, autopsy data from children as young as 10 years old, have shown evidence of fatty streaks. The presence of physiological risk factors in young people indicates that the disease process begins early in life. Secondly, cardiovascular risk factors track in youth. Bogalusa data (Berenson et al. 1985; Weber et al. 1983) show that those children identified as being at the high end of

the distribution for total cholesterol, blood pressure, or weight maintain their ranking in relationship to their peers over time. In other words, children's risk factors are not in great flux as they move from adolescence into young adulthood; the presence of a risk factor at one point in childhood is highly suggestive of the continued presence of the risk factor. Third, behaviors track throughout childhood and adolescence (Kelder et al. 1994). The children that are making poor food choices in early elementary grades are likely to be the children that are making poor food choices in junior and senior high. This important finding supports the intuitive assumption that behaviors are learned, reinforced, and solidified during childhood. Because behaviors track, nutrition education programs that teach, model, and reinforce appropriate behavioral responses starting at a young age are extremely important. Lastly, nutrition knowledge and behavior are poorly related. As demonstrated in the Kelder et al. (1995) article, the relationship between knowledge and behavior is very weak; the best predictor of future behavior was present behavior, rather than present knowledge. To summarize, these four findings, all part of a growing body of scientific evidence, highlight that planting seeds of nutrition knowledge in hopes that they will at some time in the future lead to healthy eating choices is not a good option for nutrition education of children.

Contradicting the findings related to the association of knowledge and behavior are findings from meta-analysis conducted by Johnson and Johnson (1985). They find the correlation using effect size between knowledge and behavior across 38 studies to be .5, highly significant at the .001 level and correlation of z-scores between knowledge and behavior to be .32. An explanation for this discrepancy might be the level of the association. In Kelder et al. (1995), the association is at the individual level, using a similar instrument to assess knowledge and behavior within an individual over subsequent and continuous years. The meta-analysis describes correlations across studies among different populations, measurement instruments and time periods. Further discussion in the field is necessary to ferret out the meaning of these associations.

b. The debate between traditional nutrition education and a behavioral approach

The move toward more behaviorally-based nutrition programs began in the 1980s with health promotion initiatives from the National Institutes of Health and the release of Healthy People 2000 goals. As the evidence for the diet-chronic disease connection began to mount, federal moneys became available for reducing risk factors in children through school-based health promotion programs. Specific eating patterns were targeted such as eating a lower fat or sodium diet or increasing consumption of complex carbohydrates (Stone, 1989). The interventions that were developed to target these specific behaviors often grew out of social psychology or the behavioral field, rather than nutrition education, and, in general, showed very promising results for promoting short-term behavioral change in children. In the early 80s there was a fairly clear schism between traditional nutrition education interventions, focusing on knowledge and attitude change, and health promotion interventions coming from the behavioral school. This schism is certainly narrowing with increasing

communication between traditional nutrition educators and behaviorists. Nutrition educators have much to gain from adding a behavioral perspective to their intervention strategies and the behaviorists have much to gain by using nutrition expertise in assessing eating behavior in a way that is meaningful to health outcomes.

In spite of the useful melding of ideology between nutrition education and the behavioral approach, some debate continues. Shannon et al. (1988) suggest that knowledge-based nutrition education is appropriate and models other content areas presented in elementary school curricula. She also questions that if a behavioral model is used, what behaviors should be targeted and how should those decisions be made. Olson (1989), another leader in the field of nutrition education, echoes these same concerns speculating:

"...on the one hand it is possible to demonstrate changes related to three specific behaviors with approximately 20 hours of instruction. But who decides what the target eating behaviors should be today, tomorrow, and far into the future? Are the target behaviors appropriate for everyone?...On the other hand, those same 20 hours could be used to teach children an appropriate number of the major nutrition concepts that might or might not result in consistent changes in current eating behavior. This may be another instance of the classic tension between a broad, general education philosophy and the more specific, pragmatic philosophy of education." (p. 1148)

While the debate will and should continue, one possible approach is to view behaviorally-oriented and cognitively-oriented nutrition education as two ends of a continuum which overlays progression through school or cognitive development (Figure 2).

Insert Figure 2 about here

As a child matures, more abstract nutrition information may be presented, providing the "broad, general education" that Olson describes. Early school experiences can focus on the specific, pragmatic aspects of food choice behaviors. It is during the early elementary years when most children are at the concrete stage of cognitive development, not understanding abstract concepts and causality. In addition, this is when food habits are forming (Michela and Contento, 1986). Simple behavioral messages and practicing appropriate eating behavior or food choice skills should be stressed at this time. As the child approaches junior high school, the behavioral strategies should target making food choices within a social context and the functional meanings of food. At the junior and senior high school level, more abstract and cognitively-based nutrition education may be useful, especially in the context of evaluating one's own diet and eating behavior patterns. It is at this age where abstract thinking and causal relationships can be understood. At all points on the continuum nutrition interventions should contain a behavioral component and should be appropriate for level of cognitive development.

c. Designing a behaviorally-based nutrition education intervention

What does a behaviorally based curriculum look like? A behaviorally based curriculum uses the three domains of learning (cognitive, affective, and behavioral) (Greene and Simons-Morton, 1984) to influence behavior change. Note that the final objective is behavior change. Cognitive understanding is needed to change eating behavior. However, the cognitive understanding for behaviorally based programs is not focused on the Why? but on the How?

Traditional nutrition education focused on the Why and included curricula that had such objectives as knowledge gains related to: functions of nutrients, food sources of nutrients, the digestive process, the cardiovascular system, the relationship between food and disease, etc. Previous thinking in nutrition education posited that if children understood how food worked to make them and keep them healthy, then healthful food choices would follow. Decades of work in the field have shown that knowledge gain is not related to behavioral change, even in the short term. Few of the early nutrition education programs had any follow-up of treatment results. In addition, longitudinal research has not been done to see if those early seeds of nutrition information produced desirable behavior change later in life.

Using cognitive understanding related to the How is very appropriate for nutrition education and focuses on knowledge gains related to such issues as: how to use food labels to make healthful food choices, how to prepare foods that are lower in fat, how to plan a healthful meal or snack, or how to choose healthful foods at a fast food restaurant. These How questions involve increasing cognitive understanding of how to choose a healthier diet — a behavioral objective.

The affective component of a behaviorally based nutrition education program would focus on how one relates to and uses food on an emotional or attitude level. Most programs based on social learning theory use the "affective component" to represent beliefs, attitudes and values. Little, if any, attention is paid to emotional states and food behavior. It is very appropriate for nutrition education to help children understand that food-related behavior is not just about eating to be healthy but that what we eat is shaped by how certain foods make us feel and our beliefs, attitudes and values toward food, eating and health. At the same time these affective components can be used as motivators for change. It is also appropriate for nutrition education to teach students to understand the functional meanings of foods (i.e., that food is used by many as a release of emotional stress, as a way to cope with being bored or angry, and that food is an integral part of our celebrations and traditions). It is only by understanding why we eat in addition to learning what to eat that children and adolescents can understand eating behavior in a larger, and possibly more meaningful, context than health alone.

The behavioral domain that is stressed in a behaviorally-based nutrition education program would focus on building skill levels by hands-on meal or snack preparation, learning how to set goals for making healthy choices, and learning how to reinforce oneself when those goals are reached. Skill-building

might also involve resisting peer pressure to eat a high fat entree at a fast food restaurant rather than a more healthful choice such as a salad. For younger children, behavioral change might involve learning how to ask the adult grocery shopper in their home to buy more fresh fruits or buy frozen yogurt instead of ice-cream.

Any behaviorally-based nutrition education program must, of course, be appropriate for students' stage of cognitive development (Lytle Trenkner and Kelder et al. 1991). For example, impacting the cognitive domain of an elementary child might involve teaching them that fresh fruit is a better snack choice than are potato chips, a very concrete concept. For a senior high student, impacting the cognitive domain might involve them analyzing their dietary intake for comparison with national dietary guidelines, a more abstract, causal concept.

Another approach for designing a behaviorally-based nutrition education intervention for children is the use of the conceptual model for youth health promotion that has been developed and successfully used by Perry and Jessor (1985; Perry et al. 1987; 1990). This model has its roots in social learning theory, specifically in the concept of reciprocal determinism, and posits that individual, behavioral and environmental factors influence one's health behavior.

Insert Figure 3 about here

Using this model to help design a nutrition education curriculum leads the program developer to think through strategies at each of the three levels that can be used in the curriculum to influence health behavior, in this case, eating behavior. For example, under the level of behavior, having students participate in a goal-setting exercise (i.e., eat five servings of fruits or vegetables daily) can be built in as part of the curriculum. Under the individual level, influencing knowledge of what foods are fruits and vegetables or how to prepare a fruit salad can be part of a behaviorally-based intervention. Finally, at the environmental level, the planner of a nutrition education intervention might consider working with school food service to make sure fruits and vegetables are available in the school cafeteria so that students can act on what they learn in the classroom. The nutrition educator can use this model with its three levels and 12 sub-levels as the structure for a nutrition intervention for children. In addition, this model can be used for different ages and for children at different stages of cognitive development. Note that knowledge is one of the twelve sub-levels; an important but not solitary factor in influencing behavior change. Use of theory in this manner can be a useful tool for nutrition educators.

Table 4 offers some specific nutrition intervention components crossing the Perry/Jessor model with cognitive development stages.

Insert Table 4 about here

2. Increase in minority and special-needs populations in nutrition education research

Another gain in nutrition education is the dramatic increase in research studies including minority populations. Nine of the articles reviewed include at least a 20 percent non-Caucasian sample. However, few of the studies stressed that their curriculum was developed to be culturally sensitive or used a unique channel to reach underserved populations. The article by Baranowski et al. (1990) used a family-based evening program to deliver a cardiovascular health promotion program which was met with large attrition rates. One of their conclusions was that those attempting to reach Black-American families should do preliminary work to identify salient motivations for change, to target foods to be changed in the population in general, to work with the media to prepare families for the program, and to "...bring the program to where people are already congregating (e.g., churches) or to where networks of friends already meet.." (p.441). The Hearn, et al. article (1992) reported on differential participation in a school-based program with a family intervention. None of the studies using multi-ethnic groups showed outcome difference by ethnicity, although a few controlled for ethnicity in their analyses. Since physiological risk factors differ by ethnic group (Dennison, 1994), it is important to determine if exposure and assimilation of the nutrition education programs differ by ethnicity.

One study (Devine et al. 1992) did stratify their analyses on SES level and found that students of lower SES showed greater knowledge gains with incremental increase in exposure to nutrition education in comparison to students of higher SES level. This kind of analysis of subgroups is important in understanding the impact of nutrition education on hard to reach and minority students. Obviously, these kind of data require samples with adequate numbers to conduct subgroup analysis.

Studying the effects of nutrition education on children of lower SES has received renewed attention in recent years. According to a study by the Center for the Study of Social Policy more than 11 million children in 1990 lived in households of families below the poverty level. This was an increase of 14 percent over the decade and cuts across racial and ethnic groups (Troccoli, 1993). In 1994, the Center on Hunger, Poverty and Nutrition Policy released a statement on "The link between nutrition and cognitive development in children" and in 1993 the National Health/Education Consortium released a paper entitled "Eat to Learn, Learn to Eat: The link between Nutrition and Learning in Children." Both documents discuss the relationship between adequate nourishment and children's ability to concentrate, learn and interact socially. Both documents discuss the role of nutrition programs for children, particularly the school lunch and breakfast programs. A call to enhance nutrition education initiatives is made in "Eat to Learn, Learn to Eat" (1993) including the advice to develop complementary classroom and school cafeteria nutrition education efforts. Certainly, nutrition education for disadvantaged children, including children living in poverty, will warrant increased attention and research.

3. Use of physiological endpoints

Another important advancement in nutrition education is the use of physiological endpoints to assess the impact of programs. Three of the reviewed articles (Arbeit et al. 1992; Luepker et al. 1990; Resnicow et al. 1992) look at blood lipids, blood pressures, urinary sodium, or anthropometric measures. While the Arbeit article reports only that HDL levels were significantly higher in the intervention versus control group, Resnicow reports that significant differences in total cholesterol and blood pressure are seen in the treatment conditions. These are exciting findings, especially in light of what is known about the existence and tracking of physiological risk factors in youth.

The field of nutrition education for children needs to guard against using physiological endpoints as the ultimate test of effectiveness, however. Obviously, few studies will have the financial resources to design research with adequate power to detect differences in physiological endpoints, particularly since most interventions for school-aged children are conducted in schools, with randomization at the school level. Schools, rather than individuals, become the unit of analysis, requiring many schools to be enrolled for adequate power (Murray and Hannan, 1990).

Besides the cost and power issue, there are important reasons to keep behavior change as the primary focus for nutrition education. Healthful eating behavior will result in a multitude of positive outcomes besides those that are physiologically assessed. Eating healthful foods improves childrens' energy level, school performance, and confidence in their ability to take care of themselves (Troccoli, 1993). In addition, work on the associations of healthful behaviors in children (Lytle et al. 1995) shows that children who report healthful food choices are also likely to report higher activity levels and lower smoking prevalence than are those children reporting less healthful food choices. This association between health behaviors suggests that skills or ability to make healthful decisions generalize across multiple behaviors. Another reason to maintain the behavioral focus is that the Healthy People 2000 (UDSHHS, 1990) goals focus on improved health behaviors of children and healthier environments for children rather than physiological outcomes.

4. Family involvement in nutrition education for school-aged children

Twenty-five percent of the articles reviewed involved families in the nutrition education of children. This is a commendable direction for the field to take. It is interesting and important to examine the two-way flow of communication between children and adult members of their families. There is evidence to suggest that children can and do influence nutrition behavior of their families as well as the obvious influence that adults have over nutrition behavior of children. The influence of children is demonstrated in this review in the Hearn et al. (1992) article where family participation in take home activity sheets that complemented classroom nutrition education affected the behavior of both the children and adults in the participating families. In addition, the King article (1988) showed significant differences in food availability in the home as a result

of their classroom intervention. Children can and do influence what adults purchase at the grocery store; older children may be actively involved in meal planning and preparation in the home (Kellogg's Nutrition Survey, 1992). Children's impact on family nutrition behavior should not be underestimated. Nutrition education for children with a family focus is both an opportunity to use adults in the family to reinforce what children are learning in school about healthful food choices and as a way to impact the eating patterns of adult family members.

The other direction that nutrition information flows is from adult to child. The article by Wagner et al. (1992) discussed a nutrition education program where parents receive nutrition education at the grocery store, including evaluation of their intended purchases as well as tips for how to influence their children to eat a healthy diet. The program resulted in several significant outcomes, indicating that families can be taught how to influence their children's eating behavior. Likewise, the Baranowski et al. article (1990) showed behavior change in mothers and their children attending a cardiovascular risk reduction program. There are few families who do not need help on how to get "picky eaters" to eat a healthier diet or how to combat the barrage of food-related commercials to which children are exposed. We need to work on more public health strategies to help families eat better diets, so that children can be exposed to healthier diets.

5. Community involvement in nutrition education for school-aged children

Going beyond families' influence over children's eating behavior, the Kelder et al. (1995) article gives us a first glimpse at the influence that the larger community has on children's self-reported eating behavior. Significant and persistent changes were seen in self-reported healthful food choices and nutrition knowledge in a group of students who were exposed to a low dose of nutrition education in the schools and a community-wide dose of messages regarding heart-healthy behavior, focusing on healthful food choices. These findings point to the important effect of community influence on children's food choices.

6. Innovative nutrition education programs

a. Use of computers

Some innovative nutrition education approaches emerged through this review including the use of computers, non-classroom settings for nutrition education, and peer-led nutrition education programs. This review found two articles reporting on innovative computer systems used as part of nutrition education (Wagner et al. 1992; Burnett et al. 1989). The Wagner et al. article (1992) involved using interactive video to help families evaluate their intended grocery store purchases and also to provide nutrition education on snacks and meal preparation for children. This small study resulted in some significant changes in children's snack and entree choices and knowledge scores. The Burnett et al. article (1989) used computer-generated personalized risk assessment resulting in some self-report behavior change. The use of personalized feedback is innovative and has merit for senior high students.

Previous work by White and Skinner (1988) also showed that personalized assessment was an effective intervention tool for high school students. Students at this age are able to monitor and evaluate their behavioral responses. The intervention highlights personal responsibility for health behavior change, a good lesson to be learned as students approach early adulthood.

Computers are available in most schools and today's students are computer-savvy. Computer-delivered nutrition education could be useful in allowing a student to proceed through a lesson at their own speed, target their own interests, and reducing teacher instruction time. More should be done to use the computer as a tool in nutrition education.

However, computer work without in-class interaction will not allow full integration of material and will also not accommodate many of the behavioral strategies recommended. Johnson and Johnson (1985) recommend that direct student involvement and cooperative learning activities are needed to accomplish the task of impacting nutrition attitudes and behaviors.

"Building the use of cooperative learning groups into nutrition education classes ensures that students cognitively process the information being learned, implement it into their conceptual systems and memory, form positive attitudes toward the area being studied, publicly commit themselves to learn about nutrition and eat nutritious foods, and hold each other accountable for fulfilling their commitments. Such collaborative discussions that lead to cognitive processing, public commitment and peer accountability are essential to successful nutrition education." (p. S22).

Many very innovative nutrition education programs have been developed, particularly by food companies or by state or federal agencies, but remain unevaluated. Dole has developed a CD-ROM nutrition education program to influence children to consume more fruits and vegetables. The program is wonderfully produced, using the high action video mode to which children are so drawn. Similarly, McDonalds has developed nutrition spots for television to encourage healthy eating for children. Unfortunately, no outcome evaluation has been published on either program. Therefore, nothing can be said about the effectiveness of the programs to improve children's eating behavior. Many similar examples could be cited.

Likewise, many states use Nutrition Education and Training (NET) funds to develop state-wide nutrition education programs. This and previous reviews have uncovered a few such programs that have published outcome results (St. Pierre, 1980, Devine, 1992). However, most state sponsored programs do not conduct outcome evaluations, restricting their evaluation to process evaluation. Another example is the Changing the Course curriculum, a K-12 curriculum developed by the American Cancer Society. While formative evaluation has been conducted on the curriculum (Contento, 1993) there is currently no published outcome evaluation of the curriculum. Unfortunately, many nutrition programs at the federal, state, and local levels are using innovative, creative

methods which will remain undisseminated into the larger community because of lack of evaluation. Nutrition educators who are responsible for program planning and development must be firm about obtaining adequate funds to conduct some outcome evaluation when they receive funding to develop an intervention.

b. Alternative settings for delivering nutrition education for school-aged children

While schools have been the main channel for delivering nutrition education to school-aged children, some articles reviewed study alternate settings. Connor et al. (1986) tested the feasibility of delivering a cardiovascular risk reduction program in an after-school program. Because of the increase in dual-career families, students spend an increasing amount of time in before- or after-school programs. With the increasing demands on in-school time for many curricular needs, after-school programs present an attractive option for reaching children. Unfortunately, the program tested by Connor et al. (1986) resulted in few positive outcomes. However, they did learn that classroom-type education, with lessons to be delivered in a sequential and time-sensitive manner does not work in after-school settings. Children are anxious to have unstructured time and may not attend regularly enough to allow continuity of lessons. Other approaches should be attempted to incorporate nutrition education possibilities into after-school settings. Nutrition education via computer games or activities might be a viable option. Such an approach would allow students to work on activities independently and to pick and choose when and how long they play. Similarly, a set of simple nutrition activities or games that could be completed in a short time period (i.e., 30 minutes or less) might be developed for children or groups of children to work on at their discretion.

Another approach tested was to use teenage summer camp counselors to deliver nutrition education programs to younger students (Anliker et al. 1993). This program focused on knowledge change only in the tradition nutritional education sense (increasing the Why for nutrition behavior, rather than the How) and had mixed results. However, it uses an interesting approach, students teaching students, to present nutrition education. Younger children are strongly influenced by older children; therefore, nutrition education messages delivered from older students, rather than teachers or other adult figures, might be an effective way to reach children. Work in the smoking and substance abuse area have shown peer-led health education to be effective in achieving behavior change (Perry et al 1988). Slice of Life (Perry et al, 1987) is one of the few research studies to use peer-educators in nutrition education. Good behavior change in females was achieved; however, results for males were disappointing.

B. Needs in nutrition education for children

While some significant advancements have been made in the field of nutrition education for school-aged children, there continue to be areas that need more work and emerging areas that require attention and study.

1. Tools needed for evaluating eating behavior change

This review illustrates that tools for assessing child and adolescent eating behavior still need to be developed and tested, a call that was heard in the past reviews (Contento et al. 1992, Saylor et al. 1982, Lytle Trenkner et al. 1991). Of the studies included in this review, 53 percent included information regarding the reliability of the assessment tool; 18 percent included information regarding validation of the assessment method.

This call does not suggest that all assessment tools for eating behavior need to be highly quantified and nutrient-specific measures. Such rigorous measures are very expensive and often not feasible in field settings. Much can be gained by using simple food frequencies or checklists to rank individuals, an important gain in epidemiological studies (Block, 1982). However, even food frequencies or food checklists should include some reliability and, ideally, validity testing to allow some confidence in the reproducibility of results.

2. Targeting multi-ethnic groups

While the research looking at multi-ethnic groups has increased, little has been done to look at differential effects of interventions on ethnic groups or to study interventions targeting strategies for different ethnic or cultural groups. The first issue could be addressed by doing subgroup analysis; however, adequate sample size is needed to assure sufficient numbers to analyze. The second issue could be addressed by doing careful formative evaluation in different ethnic groups to assess ethnic-specific needs, motivations and concerns. In particular, opportunities to participate in healthy lifestyle choices must be available in all communities; too frequently opportunities are not available for all.

3. More work is needed with families

While significant gains have been made in developing family components for nutrition education, more work is warranted. In particular, work is needed on eating behavior change of children and adults when they are exposed to a family program; maintenance of change after the end of the program is also important to assess. In addition, more work is needed on training parents to influence their children's food choice behavior positively and to be aware of how influential their own food choices and eating behaviors are on their children. Parents and other adults will continue to be strong influences on children's eating behavior, particularly elementary aged children. Nutrition education for school aged children must recognize and employ the two-way flow of information targeting nutrition education programs to both adults and children.

4. Functional meanings of foods

Besides helping families learn how to improve the healthfulness of foods available at home, families also need nutrition education on the affective side of food choice behavior. Qualitative research by Lytle (1993) shows that children learn much more from families than what to eat. In focus groups and one-on-one

interviews, children from K-6th grade talked about what the word "diet" meant, what influences what they eat, and how food is related to health. Strong adult and parental attitudes regarding weight loss, body image, and food choices were revealed in children's discussions. Adults need to appreciate more fully how instructive their actions and attitudes toward food are and how deeply those actions and attitudes are assimilated by their children. For example, children as young as kindergarten associated the word "diet" with weight-loss diet. Many remarked that when adults go on a weight-loss diet they eat bad-tasting or special diet foods, or only eat salads. Many children remarked that they didn't understand why their parent thought they needed to lose weight, since they looked fine to them. No child mentioned that parents increase their exercise level when they were dieting. It is very likely that children learn functional meanings of food from parents or adults in the home. If food is used by parents to relieve boredom, to handle stress or anger, or to win love and attention, children will most likely grow up using food for similar purposes (Perry, Lytle, and Kelder, 1994).

This development of functional meanings might be most appropriately addressed in junior or senior high nutrition education classes. Nutrition education using behavior modification-type strategies might be helpful for adolescents to understand habits surrounding eating behavior, social influences of eating, and cues and reinforcement for eating. Students could be taught to keep a food record that records not only what they eat but also what is triggering the eating behavior, what environmental cues precede the behavior, what reinforces the behavior, etc. (Ferguson, 1977; Brownell, 1988). Exposing junior and senior high students to such behavior modification strategies might be useful in helping them better understand what motivates and reinforces their eating behavior. Such an approach could be integrated into psychology classes. This might also be a fertile area for peer-led education.

More work is also needed in educating students on food advertising. Just as students are taught to critically look at tobacco and alcohol advertisements as part of substance abuse interventions, students should also be taught how to critically evaluate food advertisements.

5. More work is needed in communities

More work needs to be done with communities so that children grow up in an environment where healthful eating behavior is normative, modeled, and reinforced. Other community institutions including churches, community centers, libraries, worksites, and, probably most important, the media, need to be targeted for nutrition education messages.

Worksite wellness programs might be one way to promote communitywide health behavior change. In particular, targeting schools with worksite wellness programs, might facilitate the development of a healthier school environment for children.

Our children will have healthier diets when the communities in which they live consume healthier diets. The converse of that statement is sadly manifesting itself. As adult diets have become higher in fat, children's diets have followed suit (Wright et al. 1990). Likewise, as obesity becomes an increasing problem in the adult population, obesity rates for children are also on the rise (Gortmaker et al. 1987). One of the goals of nutrition education must be to have healthier diets consumed in the population; the influence will be manifested concomitantly in our children.

VI. IMPLICATIONS FOR NUTRITION EDUCATION POLICY, RESEARCH, AND PROGRAM IMPLEMENTATION

Three reviews of nutrition education programs for school-aged children for the time period, 1980-1994, have been conducted: Lytle-Trenkner and Kelder et al. 1991; Contento et al. 1992; and the current review. Looking across all those studies reviewed, two questions will be addressed in the following section: What components of nutrition education programs seem to be the most effective in achieving behavior change? and How can we maximize the implementation and institutionalization of nutrition education programming?

A. What components of nutrition education programs seem to be the most effective in achieving behavior change?

Looking across the studies reviewed, six elements of effective nutrition education programs emerge: 1) Programs are behaviorally-based and theory-driven, 2) Programs for older children include a self-evaluation or self-assessment component, 3) Family involvement is incorporated, 4) Attempts are made to intervene on the school environment, 5) Attempts are made to impact the community, and 6) Larger doses of intervention result in greater program impact.

1) Programs are behaviorally-based and theory-driven

Although there is debate regarding whether nutrition education for school-aged children should focus on specific behaviors or more general nutrition education the studies reviewed to date show that those programs targeting some specific behaviors, such as choosing lower fat or lower sodium foods, result in more behavioral changes. A program that has been particularly effective at not only achieving behavioral change, but physiological change as well, is the Know Your Body Program (KYB), a multi-year, multicomponent, sequential school-based program for grades K-7. In addition to a year long, classroom-based component involving 30-45 minutes weekly targeting reduction of fat, saturated fat, salt and increasing complex carbohydrates, the program also includes risk factor screening for serum lipids, percent body fat, blood pressure, pulse recovery and saliva cotinine. Evaluations of the program (Walter, 1989; Bush et al 1989) showed significant improvements in physiological endpoints as well as dietary intake. Two articles reporting on KYB are included in this review (Resnicow et al. 1992; Resnicow et al 1993). A longitudinal and post-test cohort

study of children in grades 1-6 showed significant differences between treatment conditions for consumption patterns as well as total cholesterol and blood pressure. However, when the risk factor screening component of KYB was combined with a curriculum with less of a behavioral focus (Resnicow, 1993) significant behavioral outcomes were only seen with intake of high fat foods.

Other programs that have focused on risk-reducing food behaviors and have had some success in achieving behavior change include Hearty Heart and Friends (Perry et al, 1985; Luepker et al, 1988), Slice of Life (Perry et al 1987), Go For Health (Parcel et al, 1989), Great Sensation Study (Coates et al. 1985), the Adolescent Heart Health program (Killen et al, 1989), the study of Black American families by Baranowski, et al (1990), Gimme Five (Domel et al 1993), a behavior-change strategy program for high school students (White and Skinner, 1988), CATCH family component pilot work (Hearn et al, 1992) and the Class of 89 Study (Kelder et al. 1995).

Most of the behaviorally-based studies cite Social Learning Theory or Social Cognitive Theory (SCT) as the conceptual framework on which the programs are based. The elements of SCT that are seen in many of these more successful programs include: goal setting, role modeling, enhancing self-efficacy through skill-building, experiential, hands on learning, reinforcements, incentives for change, building normative support for desired behavior change and creating more supportive environments.

Use of a behaviorally-based program does not guarantee uniformly positive changes in eating behaviors; most of the studies reported here had mixed behavioral outcomes. Still, the conclusion made by Contento et al in 1992 remains true today, " ..active, behaviorally-oriented methods embedded in a sound curriculum based on social learning theory are more effective for bringing about changes in behavioral skills, self-efficacy, behavioral intentions, and behaviors when these are specifically delineated." (p. 257)

2) Programs for older children include a self-evaluation or self-assessment component

Self-assessment can be viewed as a behavioral technique, however in these reviews several effective programs that focused on the use of self-assessment stand out as models of effective nutrition education programs. These programs were typically used with junior or senior high school students and used a variety of techniques for assessment. King et al (1988) used self-assessment of dietary patterns and goal setting in 10th grade students and saw significant improvements in self-reported eating behavior and availability of healthful choices at home. Burnett et al (1989) used computer-assisted self-assessment of students' health behavior, including eating behavior, with high school students. Some changes were seen with weight as well as reported fat and complex carbohydrate intake. Self-assessments were also used with 10th graders in the Slice of Life program (Perry et al 1987) resulting in a positive intervention effect for food choice behavior by females. Howison et al (1988) used self-assessment as part of their "Secrets of Success" program for fifth grade students and showed

a positive intervention effect for healthful food group choices. Finally, White and Skinner (1988) used personal diet assessment in a nutrition education intervention for high school students. Students set goals for nutrient changes in their diets. In addition to positive intervention effects between treatment groups, there were significant changes for selected nutrients.

Analyzing one's diet for inclusion of specific foods, categories of foods (i.e., high fat or low complex carbohydrates) or nutrients requires more abstract thought and is probably not appropriate for children at the elementary school level. However, research in junior and senior high suggests that students are successful at making some positive change in their reported intake by analyzing their diets and setting goals for changes. This type of activity illustrates the move to more abstract concepts of nutrition education and the more general education approach that is described on pages 46-48. In an ideal situation, students would be able to concretely see the content of their diet in terms of food groups, foods, or nutrients and set personal goals for change. This approach allows nutrition education to be targeted and individualized, enhancing students' interest in the program. Such activities have the capacity to be very instructional as well as students begin to see the contribution of specific foods to their diet and the potential for change by substituting healthier foods.

Computerized nutrition education lessons could be very effective in these types of activities. It is important to keep in mind however, that such individualized, solitary nutrition education activities should not be the sole method for teaching. Since eating is such a social behavior and since learning requires integration of information via discussion and practice (see discussion on page 57) personal diet assessment activities should be used in tandem with more behavioral and interpersonal strategies such as role modeling, discussion, hands-on skill building and peer-led education

3) Family involvement is incorporated

It makes intuitive sense that in order to impact food choice and eating behaviors of children, particularly elementary school-aged children, that families must, at the very least, provide healthful food choices and, ideally, support and encourage a child to eat healthful foods. In the past 15 years, nutrition education research has gathered good evidence that families can and will be involved in nutrition education directed toward their elementary school children; there is little evidence supporting family programs for junior and senior high students. A few studies looked at the additional intervention effect obtained when parents are involved. Kirk et al (1982) looked at the effects of a student-based curriculum versus a student-parent based curriculum with children in grades K-3. Students whose parents received a monthly newsletter complementing information children were learning in the classroom and had access to nutritionists for meal planning, reported eating a more diverse and higher quality diet than those students in the student-based curriculum. In a follow-up study of the cohort (Kirk et al, 1986) students in the student-parent curriculum reported significantly higher dietary quality scores than students in the student-only condition.

Two additional studies looking at family involvement were the Hearty Heart and Friends program (Perry et al. 1985) and the San Diego Family Heart Project (Nader et al, 1989). Perry intervened on families through activity packets sent home with students with stories of healthful role models, games to practice skills, and goal setting to change eating habits. Nader invited families to attend three months of weekly intensive intervention followed by nine months of monthly or bimonthly maintenance sessions, including parent and child-only instruction, combined family instruction and a social time with healthy snacks. Both studies reported significant behavior and physiological outcome measures.

The most recent review reports on several programs with a family component. Luepker et al (1988) report on the ability of the Hearty Heart and Home Team program to affect change in salt intake. Their results were not as clear as the results on fat intake presented by Perry et al (1985), although they did show significant intervention effects for salting behavior. Wagner et al. (1992) described a grocery store program where families received information about lower-fat and higher-fiber foods, meal preparation for children and children's snacks. No significant intervention effects for behaviors were reported.

Formative evaluation work by Crockett et al (1988,1989) found that parents preferred to participate with their child's nutrition education through activity sheets, or homeworktype assignments. Parents were less interested in attending weeknight or weekend sessions or receiving phone calls. Both the Perry and Nader family-based studies demonstrate that it is possible to get parents to participate in health promotion programs . Perry reported 71% of all invited families completed all five weeks of the home-based activities and 86% completed at least a portion of the activities. While Nader had fewer families agree to participate in the program, of those families that agreed to participate, average attendance for the 12 weekly sessions was 71% for Anglo families and 58% for Mexican-Americans. Baranowski et al (1990) report on a family program similar to the approach used by Nader et al (1989) and experienced difficulty in maintaining attendance levels for the evening programming.

CATCH (Perry et al, 1990) is testing the added effectiveness of a family component to a school-based cardiovascular risk reduction curriculum in the largest multisite school-based intervention program ever funded. The Hearn et al article (1992) cited in the current review previews family acceptance and behavior change in a pre-post evaluation of the program. When CATCH results are released in the next year, important information will be available on the effect of the family component as compared to school-based only and a control condition on such outcome measures as: serum cholesterol, anthropometric measures, blood pressure, dietary intake as assessed via a 24 hour recall, physical activity measures as well as knowledge, attitude and food behavior scores.

However, CATCH results will not be able to evaluate how the intervention affected family behaviors or physiological outcomes. As discussed on page 56, more work is needed to evaluate the effect, both at the child and family level, of the two-way communication about food and eating behavior which occurs in

families. In addition, more work is needed on how families influence and reinforce the functional meaning of foods for their children and how interventions can be structured for improving the role of food in family life.

Although much work is needed, it appears that peers and the media, rather than families, are more important channels of influence for junior and senior high students.

4) Attempts are made to intervene on the school environment

Comprehensive school health programs in the 1980s opened up the field of nutrition education, moving it out of the classroom and into the larger school environment. Nutrition education meets with the larger school environment at two important junctures: the school cafeteria and food-related policy in schools.

There has been some research in intervening upon foods served in the school cafeteria (Lytle et al. 1993) however, this discussion will focus upon only those cafeteria programs that are part of a larger, comprehensive school health program or when there was a planned link between the cafeteria and classroom nutrition education and some student level outcomes. The potential impact of school food service on children's food choices and nutritional intakes is substantial; 25 million children daily eat lunch at school. About 5 million children daily eat breakfast at school (SNDA, 1994). In addition, more children from lower SES backgrounds participate in the school meal programs than do children from higher SES backgrounds. This reality highlights the need to consider nutrition education efforts in different SES, racial, and ethnic groups.

Go For Health (Parcel, et al 1989) was one of the first studies to modify the school lunch in order to increase students' exposure to lower fat and sodium foods as part of a comprehensive health curriculum. While the combined classroom and cafeteria intervention did not significantly change students' selection of more healthful foods, the cafeteria intervention was able to reduce the fat and sodium content of school meals (Simons-Morten et al, 1991). Heart Smart (Frank et al, 1989; Arbeit et al 1992) include classroom and cafeteria interventions for cardiovascular risk reduction program with results that are difficult to interpret. The Arbeit study (1992) reported in this review indicates that there were significant increases in HDL levels in the intervention group but behavioral differences are not reported.

The CATCH study (Perry et al, 1990) includes a cafeteria intervention, Eat Smart, (Nicklas et al, 1990) modifying fat and sodium content of school meals through menu planning, food preparation and purchasing and promotion of school meals. Links between the cafeteria and the classroom curriculum are important factors in the total intervention. Results from CATCH will allow comparison of students' food behaviors and 24 hour recalls between treatment conditions and will assess the effectiveness of cafeteria interventions to reduce fat and sodium of meals as offered. CATCH will not allow evaluation of the independent individual effects of the cafeteria or classroom interventions since a factorial design was not used.

The move toward improving children's exposure to healthful foods via school food service is occurring. The School Nutrition Dietary Assessment Study (SNDA 1994), conducted by Mathematica under a contract from USDA showed that school meals as offered were providing 37% of calories from total fat and 15% of calories from saturated fat, exceeding recommendations in the US Dietary Guidelines. One of the results of that study is the release of the Healthy School Meals Initiative (USDA, 1994) which proposes: replacing the current meal component menu planning system with a nutrient-based menu planning system, increasing in nutrition education efforts, and streamlining the administration of the National School Lunch Program. If approved by Congress, the new regulations would begin in 1998. The change in school food service and children's choices could be dramatic.

The other juncture where nutrition education and the larger school environment meet is school policy around food and eating behaviors. To date, there has been little work done on schools' nutrition policy, outside of the National School Lunch Program.

The school, including teachers, administrators, peers, classroom activities, school programs and extracurricular events, make up an important and very significant part of a child's larger environment. As such, behaviors that are modeled, opportunity for choice, reinforcements and incentives in the school environment will have a significant impact on children. Consider just a few examples of food use in the larger school environment:

- teachers using candy as rewards
- the presence of pop, chips and candy in vending machines and the absence of fruit juice, fresh fruit, lowfat yogurt or milk, or pretzels as vending choices
- teachers giving coupons from pizza franchises for reading awards
- selling candy for fund-raisers
- adults at school skipping lunch because of dieting or not liking cafeteria food
- fast food franchises selling food in the school cafeteria

The timeless adage "Actions speak louder than words" definitely applies to food and nutrition practices in schools.

While much work has been done on school policy with regard to tobacco, alcohol and drug use, very little policy work has been done with nutrition. Discussion and research in this area is needed.

5) Attempts are made to impact the community

There have been three major community cardiovascular risk reduction trials: the Stanford community trials, Pawtucket, and the Minnesota Heart Health Program (MHHP) (Blackburn et al 1984). The majority of the findings for children or adolescents are reported in results from the Class of 89 study, part of MHHP. One article reviewed (Kelder et al, 1995) reports on the effects of food choice behavior when a cohort of students, from their 6-12th grade years, are exposed to both school and community interventions and messages regarding healthy food choices. Significant intervention effects for food choice behavior are seen in the intervention community as compared to the control community. These effects are seen in both boys and girls and at most of the seven years of measurement.

Since the school-based interventions were rather minimal (one hour in Grade 6 and 10 sessions in Grade 10) the community intervention must take credit for much of the intervention effect. The community intervention included extensive media messages regarding heart health behavior, community screening for heart disease, labeling of heart healthful restaurant options and grocery store items and other adult and professional health education programming in the community.

Perry (1986) suggests that changes at multiple levels in the community are important in order to have an impact of norms and to optimize school-based health promotion programs. These levels include: 1) individual or self-help instruction such as direct messages given by physicians, 2) family involvement, 3) school environmental changes such as explicit and enforced policies for students, teachers, and staff, 4) community-wide campaigns in which adolescents have an active role and 5) counteradvertising against unhealthful products.

Our communities are beginning to realize that community norms influence children and adolescent behavior in the areas of smoking, alcohol and drugs. The last decade has seen community regulation of tobacco and drug-free schools, non-smoking regulations in public places, bans on advertising alcohol and cigarettes on television and limiting teenage access to cigarettes. Community regulation and policy of food-related behaviors will be much harder to sell, possibly because almost everyone uses food in a social or other-functional context. In addition, abstinence is not an option for eating behavior!

Communities might start by attempting to model and enhance exposure to healthful food choices rather than regulating against less healthful choices. Enhancing the value and appeal of fruits, vegetables or complex carbohydrates, and low fat dairy products through media and social channels is a way to begin.

The research community needs to more systematically study the effect of community interventions on young people. The experience of Class of 89 (Perry et al, 1993; Kelder et al 1993, 1995; Lytle et al, 1995) supports that adolescents receive and respond positively to community-based interventions.

6) Larger doses of intervention result in greater impact of programs.

The review of the literature suggests that exposure is related to effectiveness. The programs with the significant gains in behavioral or physiologic outcome measures were those programs of longer duration. Know Your Body has demonstrated positive intervention effects for both dietary intake measures and serum cholesterol in several evaluations of the program (Walter et al, 1989; Bush et al 1989; Resnicow et al, 1992). Know Your Body is delivered weekly for 30-45 minutes, by far the most intense health education reviewed. Most programs involve only 10-15 hours of instruction over 3-15 weeks. Research (Olson et al, 1986) indicates that about 11.1 hours per school year are spent on nutrition education. At the same time, the School Health Evaluation Study (Connell, et al, 1985) indicated that peak knowledge, attitudes and practice scores are reached with about 50 hours of instruction.

The ability of nutrition education to impact food behaviors of children needs to be considered in light of other influences on children's eating behaviors. In particular, children may view as many as three hours of food commercials each week (Nielsen Report, 1990; Contungna, 1988). Taras et al (1989) surveyed mothers of children, ages 3-8, and found that after viewing TV, their children requested foods paralleling the frequencies with which those foods were advertised on TV. Additionally, they found that weekly hours of TV viewing were positively correlated with requests by children and purchases of parents as well as children's caloric intake. Dietz and Gortmaker (1985) reported on NHANES I and II data that the prevalence of obesity increased by 2% for each additional hour of television adolescents viewed, controlling for prior obesity, region, season, population density, race and SES.

New research by Kotz and Story (1994) show that of 564 food advertisements shown over 52.5 hours of Saturday morning television programming, 50.3% would fit in the Food Guide Pyramid under "Fats, oils and sweets", 43.4% were in the Bread, cereal and pasta group (mostly from ads for breakfast cereals) and no advertisements for fruits or vegetables were run.

Food companies have been very effective in applying social marketing and behavioral strategies to their advertisements. Over one-third of the commercials appealed explicitly to taste, while almost 17% used incentives (free toy) to encourage children to buy the product. Another 24% of the commercials used enticements of the food being fun, cool or hip to get kids to ask for the product. Only 2.4% of the ads highlighted nutrition as a reason to buy the product (Kotz and Story, 1994).

If nutrition education is going to have a chance of competing with the barrage of messages children get in their larger environment, particularly from media messages, a commitment to nutrition education must be made at the federal, state, district and school level. At the federal level, support for the Nutrition Education and Training program has been cut. However, there is a move toward increased nutrition education as part of USDA Healthy School Meal

Initiatives (1994) which would be a welcome and important commitment. The proposal includes increasing links between nutrition education in the classroom with healthy food choices in the school cafeterias. Mechanisms for creating those links and details on how much and what type of nutrition education programming would occur are not yet available.

At the state level, the regulation on providing nutrition education is under a larger umbrella of health education mandates and mandates for health education are highly variable. Sixty-three percent of states require that health education be taught sometime between grades K-12 and only 37% require health education be taught between Grades 1-6. Only 37% of states include nutritional health as a part of their comprehensive school health curriculum (Lovato et al, 1989). Obviously, the commitment to nutrition education, or health education, is not strongly present at the state level.

Districts and schools also need to commit time and resources to nutrition education. Decisions about what curricula must be taught, scope and sequence of content areas, who teaches and teacher training, financial and physical space resources are often made at the district or school level. The importance of district and school policy regarding the school environment and the provision of healthful food choices and supporting healthy food attitudes and behaviors were discussed on page 73.

B. How can we maximize the implementation and institutionalization of nutrition education programming?

Research to date leaves us with more questions than answers on how to best implement and institutionalize nutrition programs. Research reviewed did not systematically study such questions as: Are programs more effective if teachers, other school personnel such as the school nurse or cafeteria worker, or some outside health educator teacher delivers the lesson? What is the optimal way to train teachers? Should training be specific to the curriculum or a broader focus on nutrition? What is the optimum number of contact hours with students? What is the optimum number of classroom sessions? What mix of activities (computer, discussion, board work, cooperative learning groups) is optimal? Is nutrition education integrated into other subjects as effective as distinct nutrition or health units? How does nutrition education fit into a move toward comprehensive school health?

While all these are important questions, this review calls for serious consideration of four important issues for implementing nutrition education for school-aged children: 1) Who should deliver school-based nutrition education? 2) Should we integrate nutrition education into other subjects? 3) How does nutrition education fit into comprehensive school health? and 4) How do we diffuse and institutionalize successful programs?

1) Who should deliver school-based nutrition education?

The first question is not a new issue for nutrition education. Most typically, classroom teachers have been trained to deliver nutrition education units. Training requires time and money and does not guarantee that the teacher will implement the curriculum as designed. The beginnings of research into the diffusion of evaluated programs spotlights what most nutrition educators already knew. There are some teachers who will do a wonderful job of teaching their classes about nutrition. Others will not be motivated and will teach a watered-down version or will not teach it at all. The worst case is the teacher that teaches an inaccurate and highly personalized approach to nutrition.

As funding cuts for schools increase and as more state requirements are added to the curriculum, training and implementation time are threatened. Funding for the NET program has declined from initial funding levels of \$20 million dollars in 1978 to \$5 million dollars in 1980 (Kalina et al, 1989). Whether or not there is time available for training of teachers and class time for implementation of a nutrition curriculum ultimately becomes a policy decision made at the school, district, state, or federal level. Policy makers need to be educated, or reminded, of the importance of learning about healthy eating from both a proximal time frame (i.e., a well-nourished child learns better, feels better, and has less absenteeism) (Troccoli, 1993; Center on Hunger, Poverty and Nutrition Policy, 1994) as well in a distal time frame (i.e., the prevalence of obesity and other chronic disease risk factors is on the rise in children).

Assuming there is time for nutrition, who should teach it? How should they be trained? How can fidelity of curriculum be maintained? Should a basic course in nutrition be required in the training of elementary and secondary school teachers? Should money be allocated to pay for a district-wide nutrition education teacher or a health education teacher skilled in nutrition? Again, these questions are aimed at policy makers.

Teacher training is an obvious issue for implementation of nutrition education in the classroom. Articles reviewed show little emphasis on training aspects of the program. The Devine article (1992) discusses differences in home and skills class teachers and health teachers in implementation and effectiveness. Only two (King et al, 1988; Green et al. 1991) of the school-based programs used other than classroom teachers to deliver the curriculum.

The current reality in schools is that classroom teachers are usually responsible for implementing nutrition education in their classrooms. Oftentimes classroom teachers are also responsible for initiating the need for nutrition education and choosing the curriculum they will use. Teachers, therefore, are very important gatekeepers for nutrition education.

This predicament requires careful consideration by developers of school-based nutrition education programs. Some possibilities to consider are: 1) Use health or nutrition educators, rather than classroom teachers, to deliver

nutrition education or comprehensive health education. This solution would provide for well-trained and motivated instructors. Cost and time issues remain as an obstacle. Can school administrators be convinced that health or nutrition education is important enough that financial resources be used to hire an outside person to teach? How will health or nutrition education fit in to an already-busy school day? 2) Make nutrition and health education as user-friendly as possible. Nutrition educators developing nutrition education curricula should work closely with classroom teachers to make sure that the format, length, content, and activities of lessons are appropriate and feasible. 3) Use programmed learning type modules for nutrition education. These modules would be completed on an individual basis and could allow for different learning styles and abilities. The modules could be activity- or reading-based (similar to the SRA reading system) or could be computerized lessons. The advantage of this system would be that teachers would not need to present content information; the obvious disadvantage of this system is the lack of experiential learning opportunities and social interaction and reinforcement that is so important in food choice behavior. Johnson and Johnson (1985) suggest that in order for nutrition education to be accepted into classrooms nutrition educators must anticipate where educational materials and innovations are moving and then prepare state of the art programs for teachers to use.

2) Should nutrition education be integrated into other subjects?

Choosing to teach nutrition education is not a clear-cut matter for teachers or schools. Nutrition must compete with many other curricular demands. There is a growing move to go back to the basics with competency testing in the core curricula (i.e., math, reading, social studies) and a move away from "extras" like nutrition education or physical education. Likewise, there is a growing move toward integrating health topics into the core curriculum. Rather than have a distinct unit on nutrition, nutrition topics would be covered in math, social science, reading, etc.. While this approach makes intuitive sense given the time constraints teachers are under, there are practical problems with application of this approach. One of the obvious obstacles is the amount of planning and coordination that would be required with integrated health curriculum. An almost school-by-school plan would have to be devised and carried out, using the specific textbooks and lesson plans of the teachers. The plan would change year by year as teachers migrate in and out of the school and lesson plans and textbooks change.

Integrating nutrition education into other curricular areas helps to resolve the problem of not having time to teach a distinct nutrition education unit. In the 1970s, the Dairy Council developed a K-12 curriculum called "Food Your Choice," which was designed to be integrated into other subject areas. The impact of Food Your Choice was reported on a piecemeal basis (Lewis et al, 1988;) and in technical reports. It is summarized in the meta-analysis and by Johnson and Johnson (1985). While these reports suggest that the program is effective in influencing knowledge, attitudes and behaviors, evaluations of the total program have not been scrutinized by peer review process in scientific journals and have not been included in other major reviews to date.

The question posed to nutrition educators developing curricula for school-aged children is: Is a nutrition education curriculum integrated into other subject areas feasible? If the answer is affirmative, nutrition educators need to begin serious work with experts in other curricular fields to begin the process. Evaluation strategies need to be planned and executed. If the answer is negative, then nutrition educators need to direct their attention to programs that stand alone as distinct units or begin working as a team on comprehensive school health education. If integration is the goal, then state-wide nutrition curriculum is likely not feasible and policy makers will be put to the test of writing objectives for nutrition education which need to be operationalized at the school level. Again, money must be available for the task of nutrition component development and teacher training at the school level.

3) How does nutrition education fit into comprehensive school health?

There is also a move toward comprehensive school health education (Iverson and Kolbe 1983), presenting challenges and opportunities for nutrition education. Five of the articles reviewed had a nutrition component as part of comprehensive school health (Resnicow, 1992, 1993; Kelder et al. 1995; Hearn et al. 1992; and Arbeit et al. 1992). Previous reviews also discussed nutrition programs imbedded in comprehensive school health programs (Contento et al, 1992; Lytle Trenkner et al, 1991). Comprehensive school health education suggests that a health curriculum be adopted at a school or district with appropriate scope and sequence for grades K-12, targeting a multitude of health topics including nutrition, exercise, smoking prevention, and substance abuse prevention. Comprehensive health education also suggests that schools should be healthful environments, allowing students the opportunity to have healthful food choices in the cafeteria, opportunity to get physical activity, and to learn in a smoke-free environment (Allensworth and Kolbe, 1987). Nutrition as part of comprehensive school health is a good idea; food related behaviors have been shown to covary with other health behaviors (Lytle et al. 1994). Comprehensive health education also has the opportunity to place nutrition issues in the larger rubric of overall health and well-being, the holistic approach called for by Lytle Trenkner et al. (1991).

How does nutrition education fit into comprehensive school health? Nutrition has been a major focus in comprehensive school health programs (Stone, 1989), both in content areas for classroom-based curricula as well as school environmental changes relating to decreasing the fat in school lunch. The challenge will become completing the vision of comprehensive school health, which raises questions such as: How does nutrition education look in the scope and sequence chart of Kindergarten through Grade 12 comprehensive health education? Does nutrition need to be included in each grade level? What content areas and behavioral approaches should be used at different grade levels? Will comprehensive school health include nutrition as a component imbedded in larger health issues or will nutrition function as a separate unit used in certain grades? Where will comprehensive school health fit into a school's curricular

plan? Will it be mandated or optional? Who will teach comprehensive school health? Who or what agency will develop the plan?

Again, the problem stands in feasibility. Where will schools get the resources and time to implement comprehensive school health? Who will teach health? Classroom teachers rarely have a health background, potentially leading to a lack of: 1) knowledge in the content area, 2) recognition of the importance of a health curriculum, and 3) confidence in their ability to teach a health curriculum. These three conditions will usually result in a teacher deciding either not to teach health or to teach a watered-down version of the health curriculum.

4) How do we diffuse and institutionalize successful programs?

More nutrition education research needs to be conducted into the diffusion of programs and the effectiveness of programs delivered in non-research settings. Research on diffusion of innovations began in the field of sociology (Rogers, 1983) and studies the process by which new ideas, programs, or technologies are introduced, accepted, adopted, and become ingrained. The stages in the diffusion process are: dissemination (introducing the program to an institution or an individual), adoption (the institution/individual decides to adopt the program), implementation (the program is put into place in the institution/individual), and institutionalization (the program becomes thoroughly ingrained in the institution/individual with continued strong commitment to the program (Parcel et al, 1990). Recently, the diffusion process has been studied in school-based smoking programs (Parcel, 1989) and interesting information regarding the fate of researched programs once formal evaluation is completed is being discovered.

Teacher training can be used as an example of "figuring out" institutionalization of a program. When training has been done in research trials, the researchers most typically offer the training and pay for all expenses of the training, including paying for substitute teachers (Edmundson et al, 1994). But who organizes and conducts the training after the research project is over? In some cases, highly interested and motivated individuals (teachers or curriculum specialists) will maintain training and monitor implementation. This is the 'program champion' referred to in Smith et al. (1991). In many cases, however, the level of maintenance is decreased.

Two of the articles reviewed (Resnicow, 1993; Devine, 1992) look at previously researched programs in a more naturalistic setting. The Devine article showed that in spite of state-wide training, few teachers were implementing the Nutrition for Life curriculum as it was designed; most importantly, students' exposure to the curriculum was minimal, limiting its effectiveness. Resnicow et al. 1993 also reported on the effectiveness of the Know Your Body program using a reduced university support staff to guide teachers in implementing the intervention. Resnicow also noted that only 12% of students had "high impact teachers" during the final two years of the study, suggesting that teachers were not implementing the curriculum to its fullest advantage. While both articles report some positive results, the loss of impact due to teachers who are not well trained and schools that do not have a long-term commitment to nutrition education and

resources necessary to insure its implementation (including time, personnel, money) was obvious.

Smith et al. (1992) report on the institutionalization of the "Growing Healthy" comprehensive school health curriculum in eight schools trained and, at one time, implementing the curriculum. A survey of the schools revealed that only two of the schools were still implementing the curriculum. The primary reasons for discontinuing the curriculum were loss of the program champions and insufficient administrative leadership.

The question of how to diffuse and institutionalize successful programs is far from being answered. Both additional research as well as nutrition policy re-evaluation must occur before we can make strides in this area.

VIII. CONCLUSION

The reviews of nutrition education programs for school-aged children since 1980 show some significant advancements in the field.

- We are making gains in a number of important areas. There are an increasing number of nutrition education programs being evaluated in multi-ethnic groups. Innovative approaches such as computer-assisted nutrition programs, grocery-store-centered programs, and after-school nutrition programs are being tested. The study of the family's influence on nutrition education for children is increasing. Research methodologies are being improved by the use of control groups and more sophisticated analyses plans. The study of the diffusion of nutrition education is being initiated, shedding light on the realities of program maintenance.
- We know that nutrition education can have an impact on children's knowledge acquisition and that behavioral change is possible as well. The first studies are coming out showing that physiological changes can also be detected as outcomes of nutrition education programs.
- We know that behaviorally based programs with a theoretical basis are the most effective for achieving behavior change.
- We know that junior and senior high students can achieve some behavior change by the use of self-assessment activities.
- We know that using families to support school-based nutrition education for elementary-aged children is feasible and results in some positive behavioral changes. We have also learned a great deal about what types of programs families are willing to participate in and what formats pose excessive barriers.

- We have learned that schools are willing to be research partners in nutrition education research, an essential element if nutrition education programs are to be evaluated. Schools are also targeted for improving children's opportunity to choose healthful meals.
- We have a glimpse of how effective community-based programs can be on youth eating behaviors.
- We know that "more is better". Programs with longer duration and more contact hours get more positive results than shorter programs.

A number of issues pose important questions and challenges, including:

- Finding appropriate methods for measuring eating behavior change.
- Increasing research on ethnically diverse populations.
- Working more effectively with families to influence child and family behaviors.
- Educating students on functional meanings of foods and the relationship to eating behavior.
- Educating students on the media's influence on food choices.
- Making our communities better environments for healthy eating choices.

Finally, a multitude of questions exist on how to implement and institutionalize effective nutrition programs for school-aged children. Many of these questions boil down to resource and barrier issues. Resource questions include:

- Who will teach nutrition education?
- Who will pay for training of nutrition educators or school foodservice staff?
- How will a school's time resources accommodate nutrition education?
- How will schools afford nutrition education or other health curriculum?

Barrier issues include:

- Lack of time in a school day/year for adequate nutrition education.
- Lack of school/district/state/ or federal policy encouraging nutrition education.
- Lack of adequately trained teachers.

- Lack of school-level policy related to food-related issues.
- Stiff competition from mass media for less healthful foods.

These are important issues for nutrition educators to begin to address through discussion and problem-solving; the issues will ultimately be affected by policy makers. Policy makers will, most likely, make their decisions based on a cost-benefit analysis. Nutrition educators need to continue to plan effective programs using state-of-the-art knowledge about what makes a program effective. In addition, they need to conduct thoughtful and careful evaluations of the programs so that changes can be demonstrated. They are equally challenged to begin to design effective programs across racial, ethnic, cultural and grade levels. They are challenged to begin working on maximizing implementation and institutionalization of effective programs. Finally, they need to champion the fact that helping children develop healthful eating patterns will have long-term and short-term benefits for our society.

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Tables and Figures

Table 1
Intervention Summary

	Theory Used	Content	Dose # Sessions, Length	Where Taught	Who Taught	Teacher Training	Funding Source
German et al. 1981	None given	•Nutrient density approach for evaluating the quality of the diet	10 sequential lessons (2 weeks)	Health class	Health teachers	Provided background information to health teachers on: 1) nutrient needs; 2) nutrient density concept; 3) energy balance and weight control	Not given
Connor 1986	None given	•Interrelationship among heart facts and concepts •Risk factors of heart disease •Relationship of current decisions and behavior with the prevention of disease	Aerobic Exercise Program 12 weeks, 3 - 45-minute sessions/week	After-school program Heart Health Education Prg. 2, 30-min lessons/week	After-school teachers	Brief inservice	American Heart Assn, San Francisco Chapter
King et al. 1988	Social Learning Strategies	•Food myth/facts •Self assessment of eating behavior •Setting goals	3-week, 5-session 50-min/session	High school 10th grade	Masters-level health professional, regular teachers present in classroom	None	NHLBI
Luekper et al. 1988 75	Social Learning Theory	•Curriculum Complex Carbohydrates, low-fat, low salt •Physical activity Assessment, aerobic workouts •Homework w/parents •Preparation of snacks	5 week, 15 session = Hearty Heart 5 week correspondence = Home Team	3rd grade classroom-based = Hearty Heart Home-based = Home Team	3rd grade classroom teachers	Inservice training	NHLBI 8

Table 1
Intervention Summary (Continued)

	Theory Used	Content	Dose # Sessions, Length	Where Taught	Who Taught	Teacher Training	Funding Source
Burnett et al. 1989	Not given	Computer-assisted feedback condition Student Health Behavior Survey (SHBS) was administered 5 times and feedback and advice provided for individual students. Health tip sheets on specific foods were provided	SHBS administered 5 times with feedback each time 14 one-page tip sheets	Classroom	Research staff	NA	Spencer Research Foundation
Baranowski et al. 1990	SLT Social support adult education	•Behavioral counseling •Group education •Aerobic activity •Healthy snack	90-minute/session 1 education & 2 physical activity sessions/week 14 weeks	Community center	Nutritionists Health educators Exercise physiologists Aerobic dance instructor	NA	NHLBI
Green et al. 1991	None given	•Overview of calcium, phosphorus & Vit. D •RDA of calcium, phosphorus & Vit. D •Recommended amount of milk •Calcium, phosphorus, Vit. D & disease connections	3 sequential lessons, 55 minutes each	Special class during regularly-scheduled physical education class	Research staff	None	Not given
Arbeit et al. 1992	PRECEDE model Social cognitive theory	•Heart Smart reduced sugar, fat, sodium school lunch •PE program fitness aerobic conditioning •CV risk factor screening	2-1/2 years	Elementary schools; 4th & 5th grade analysis K-6 curriculum	Classroom teachers	•2-day inservice •Bimonthly booster sessions •Optional nutrition & exercise sessions	NHLBI

Table 1
Intervention Summary (Continued)

	Theory Used	Content	Dose # Sessions, Length	Where Taught	Who Taught	Teacher Training	Funding Source
Divine et al. 1992	None given	•Nutrition for Life •Focus on eating to promote health & well-being •Nutrition/food choices •Nutritional needs over life span •Nutrition & fitness	Median: 3 hrs Range: 1-39 hrs	Health & home/ career skills classes	Classroom teachers	Workshops led by community- based peer training teams	NY State Dept of Hlth. Bureau of Nutrition & Cornell University
Hearn et al. 1992	Social Learning Theory	3rd grade: Hearty Heart Home Team 4th grade: Stowaway to Planet Strongheart Adventure stories, games, activities, recipes, goal setting activities	5 weekly take- home packets 6 weekly take- home packets	Home activity	Child and parent interaction	NA	NHLBI
Resnicon et al. 1992	Social Learning Theory & PRECEDE model	Classroom curriculum, school-wide activities	At least once/ week 30-45 minutes, entire school years: Feb. 88 - June 90 (2-1/2 yrs)	1-4 grade classroom	Classroom teachers	1-2 days by experienced KYB staff	Ford Foundation; Cancer Research Foundation of America
Wagner et al. 1992	None given	•Weekly feedback on intended grocery purchases •reducing fat & increasing fiber •Simple steps toward behavior change with regard to purchasing & preparing lower-fat and higher-fiber foods •Meal preparation for children •Children's snacks	6 videos, 2-8 minutes long	Grocery store	Computer/video touchscreen	NA	National Cancer Institute

Table 1
Intervention Summary (Continued)

	Theory Used	Content	Dose # Sessions, Length	Where Taught	Who Taught	Teacher Training	Funding Source
Anliker et al. 1993	None given	•Awareness of eating habits and reasons for food choices •Food groups emphasizing particular nutrients	5 lessons	Summer Youth Nutrition Education Program 3 inner-city areas	Teachers: Co-op Extension State nutritionists Teenagers: Teachers	Teachers-5 sessions Teenagers - demonstrations	New Haven Coop Extension EFNEP/4 Program CT Summer Food Service Program Private Industry Council
Domel et al. 1993	Social Cognitive Theory -reciprocal determinism	•Enhance ability to ask for & prepare F&V •Include F&V in school lunch menu •Recipe preparation, taste-testing	6 weeks, 18 sessions	4th & 5th grade classes	Classroom teachers	Initial: 4 hours Mid-program: 2 hours	International Apple Institute
Killen et al. 1993	Not given	Lessons related to: •normal weight gain •excessive dieting •weight disregulation •cultural pressures to be thin •Healthful nutrition practice	18 lessons	Classroom	Research staff	NA	National Institute for Child Health & Development
Resnicow et al. 1993	Not given	•"Michigan Model Comprehensive School Health Education Curriculum," (MMCSHC) modeled after "Growing Healthy" and "Know Your Body Health Profile" (KYB) •Risk factor screening	Not given (MMCSHC) 6 sessions (KYB)	Classroom	Classroom teachers	1/2 day training	Michigan State Senate and Cancer Research Foundation of America
85							86

Table 1
Intervention Summary (Continued)

	Theory Used	Content	Dose # Sessions, Length	Where Taught	Who Taught	Teacher Training	Funding Source
Kelder et al. 1995	Social Learning Theory Problem Behavior Theory	Community-based intervention •mass media •public screening •restaurant labeling School-based interventions •Lunch Bag (LB) - choosing a healthy lunch •Slice of Life (SOL) - peer-led social influences	5-year community intervention 1 session (LB) 10 sessions (SOL)	Community 6th grade classrooms (LB) 10th grade classroom(SOL)	NA Classroom teacher Classroom teacher	NA In-service training	NHLBI
87							88

Table 2
Evaluation Summary

	Study Design	Sample	Number of Schools (Subjects)	Outcome Measures	Validity Evaluated?	Reliability Evaluated?
German, et al. 1981	Pre-post Non-random assignment of classes within schools to control/intervention conditions	High school students in Utah	2 schools (137)	•Knowledge •Attitude •Behavior Food Frequency Indicator	No	Some reliability testing of semantic differential attitude scales
Connor et al. 1986	Pre-post quasi-experimental Random assignment of sites into control/intervention conditions	3rd and 4th grade students in CA 44% Black 44% Hispanic 7% White 5% Other	4 sites (55)	•Knowledge •Attitude •Monitoring Heart Rate	No	No
King et al. 1988	Pre-post 1-year follow-up, random assignment of classes, one way between groups	10th grade students in California School 1 = 65% White 35% Minorities School 2 = 95% White 5% Minorities	2 schools (218)	direct/indirect observation of snack choices, self-reported measures of •knowledge •attitudes •behavior •home availability •intentions •efficacy	No	No
Luepker et al. 1988	Pre-post factorial random assignment of schools	3rd grade students in Minnesota & North Dakota, predominantly White	31 schools (1839)	•Knowledge •Sodium measured by 24-hour recall & overnight urines •Label reading •Food preparation •Food salting •Food selection •Height/weight •Skinfold thickness	No	Test-retest correlations .82 = Knowledge .85 = Food Preference .89 = Food selection (Self-report)

Table 2
Evaluation Summary (Continued)

	Study Design	Sample	Number of Schools (Subjects)	Outcome Measures	Validity Evaluated?	Reliability Evaluated?
Burnett et al. 1989	Pre-post Students selected from randomly-assigned control/intervention schools	Senior high students from Wisconsin	3 schools (77)	•Weight change •Saturated fat & cholesterol intake •Fiber and complex carbohydrate intake	No	Test-retest of student health behavior survey = .77-.89
Baranowski et al. 1990	Pre-post Random assignment of families to control/ intervention schools	Black-American families with children in the 5th, 6th, or 7th grade from Texas	96 families 120 children 114 adults	•Food frequency •24-hour recall •Behavioral capability •Self-efficacy	Food frequency previously validated	No
Green et al. 1991	Pre-post 1-month follow-up Random assignment of subject into control/ intervention conditions	9th & 10th grade females in Illinois	1 school (64)	•Knowledge •24-hour recall •Lifestyle questionnaire	No	No
Arbeit et al. 1992	Pre-post random assignment of schools into intervention/control conditions	4th & 5th grade students in Louisiana 58% White 32% Black 10% Other	4 schools (530)	CV risk factor screen- ing •Serum lipids & lipopro- teins (fasting) •Height & weight •Triceps & subscapular skinfolts •Waist circumference •Blood pressure Lifestyle assessment •Self-report school lunch Fitness assessment •run/walk CV health knowledge	No No	No Nutrition attitude Cronbach alpha = .77
Devine et al. 1992	Survey of 3 groups of teachers implementing Nutrition for Life, some other nutrition educa- tion, or no nutrition education	7th and 8th grade students in New York	103 teachers (1863)	•Knowledge •Attitude •Behavior		

Table 2
Evaluation Summary (Continued)

	Study Design	Sample	Number of Schools (Subjects)	Outcome Measures	Validity Evaluated?	Reliability Evaluated?
Hearn et al. 1992	Pre-post design Pilot work - no control	Families of 3rd & 4th graders from 4 states 69% White 15% Hispanic 10% Black 6% Other	8 schools (554 families)	Food-specific behavior	No	No
Resnicow et al 1992	Pre-post 3-year follow-up nonrandom assignment by district, 3 intervention, 2 control	Grade 1-6 students from New York & Texas; Longitudinal cohort; 60% Hispanic 23% Black 11% White Post-test cohort: 61% Hispanic 26% Black 8% White	5 schools (2973 at baseline, 1209 at Follow-up, Longitudinal cohort 3045 post-test cohort)	•Total cholesterol •Height, weight, BMI •Blood pressure •Health knowledge •Food frequency - Assessment of teacher implementation - subjective •Health attitudes •Self-efficacy	No	•Health knowledge Cronbach alpha Gr 1-2 = .54 Gr 3 = .73 Gr 4-6 = .89 •Health knowledge attitude Cronbach alpha .71 •Health knowledge self-efficacy Cronbach alpha .70 - Test-retest correlations: •Systolic = .96, .96, .98 •Diastolic = .94, .93, .96 •Health Knowledge = .62, .73, .76 •Food frequency Gr 1-3 = .46 Gr 4-6 = .50
Wagner et al. 1992	Pre-post Non-random assignment to control/intervention condition	24 families with a child between 8-16 years Mean age child = 11.2	24 families	•Knowledge •Preference •Behavior •Food History Questionnaire	No	No

Table 2
Evaluation Summary (Continued)

	Study Design	Sample	Number of Schools (Subjects)	Outcome Measures	Validity Evaluated?	Reliability Evaluated?
Anliker et al. 1993	Pre-post Non-random assignment to treatment/control	Teenagers (ages 14-17) teaching at a summer camp in Connecticut	49 teenagers	•Nutrition knowledge	No	Cronbach alpha = .76
Domel et al. 1993	Pre-post Random assignment of schools	4th & 5th grade students from Georgia Approximately: 50% Black 50% White	2 (301)	•Food diaries/ school lunch observation •Questionnaires re: Fruit and vegetable preferences and knowledge	•Food diaries/ school lunch observation	•Preference internal consistency Fruits = .73 Vegetables = .70 Fruit & Veg. snacks = .74 (baseline) Knowledge internal consistency = .59 (baseline)
Killen et al. 1993	Pre-post follow-up Random assignment of classes to intervention/control conditions	7th & 8th grade girls in Northern California 41% White 22% Hispanic 20% Asian 4% Black 13% Other	4 schools (967)	•Height •weight •BMI •Knowledge •Eating disorders indices	Eating disorders indices validated	No
Resnicow et al. 1993	Pre-post design Non-random assignment of schools to intervention/control condition	Michigan school children, grades 1-6 71% White 25% Black 4% Other	8 schools (1166)	•Knowledge •Attitudes •Behavior	No	Cronbach alpha for knowledge scale = .74-.80 Cronbach alpha for attitudes scales = .42-.75
Kelder et al. 1995	Longitudinal cohort study of students from 6th through 12th grade. Communities randomized into control & intervention conditions	Students from Fargo-Moorehead, North Dakota & Sioux Falls, South Dakota followed from 6th - 12th grades Primarily White	13 - 7 schools (2376 - 1069)	•Knowledge •Food choice behavior •Salting practice	No	Cronbach alpha for food Knowledge scores = .69-.83 Test-Retest for food choice score = .59 Test-Retest for food knowledge score = .63

Table 3
Study Outcomes

German et al. 1981

Knowledge

Significant difference in knowledge gain between treatment conditions

Attitudes

No significant difference

Behaviors

Food Frequency Indicator

General eating patterns - No significant difference

Frequency of consumption of 110 food items - No significant difference

Physiological

None

Connor et al. 1986

Knowledge

Significant difference in knowledge gain between treatment conditions

Attitudes

No significant difference

Behaviors - None

Physiological

Heart Rate Monitoring- No significant difference

King et al. 1988

Knowledge

Significant difference in knowledge gain between treatment conditions

Attitudes

Attitude related to dietary practices - No significant difference

Self-efficacy - No significant difference

Behavioral intention - No significant difference

Behaviors

Home availability - Significantly different between treatment groups

Reported behavior - Significantly different between treatment groups

Observed snack choice - No significant difference

Coupon for future snack choice - No significant difference

Physiological - None

Luepker et al. 1988

Knowledge

Significantly different between treatment groups (10/12 comparisons)

Attitudes - None

Behaviors

Tasting food before salting - Significant between Control and HH alone group

Salting after tasting - Significant between Control and HH and HT combined group

24 hour recall - Intake of sodium per 1000 kcals significantly decreased in control and increased in intervention groups

Physiological

Sodium excretion- No significant differences between treatment groups

Table 3
Study Outcomes (cont.)

Burnett et al. 1989

Knowledge - None

Attitudes - None

Behaviors

Weight change for subjects more than 10% underweight - No significant difference

Weight change for subjects more than 10% overweight - Significant differences pre-post in computer feedback group

Saturated fat and cholesterol intake - Significant differences pre-post in computer feedback and assessment only conditions

Fiber and complex carbohydrate intake - Significant differences pre-post in computer feedback and health tip conditions (Health tip change in wrong direction)

Physiological - None

Baranowski et al. 1990

Knowledge - None

Attitudes

Behavioral capability - No significant differences

Self-efficacy - No significant differences

Behaviors

Food Frequency - Significant differences in treatment group for high total fat foods, high saturated fat foods, high polyunsaturated foods, and high calcium foods (PFA and CA difference in wrong direction)

24 hour recall - No significant differences

Physiological - None

Green et al. 1991

Knowledge

Significant differences between treatment group

Attitudes - None

Behaviors

24 hour recall - No significant differences in Calcium or Vitamin D intake between treatment

Physiological - None

Arbeit, et al. 1992

Knowledge

No significant differences between treatment groups

Attitudes - None

Behaviors

Lunch selection - Significant testing between groups not reported

Physiological

Significant increase in HDL levels in intervention condition

Table 3
Study Outcomes (cont.)

Devine, et al. 1992

Knowledge

Significant differences seen between NFL and No teach in Health classes; no significant differences between groups among home and career classes.

Attitudes

Significant differences seen in both health and home and career classes.

Behaviors

Ten - item nutrition behavior scale - Significant differences seen in home and career classes; no significant differences in health classes

Physiological - None

Hearn et al. 1992

Knowledge - None

Attitudes - None

Behaviors

Six food specific behaviors, looking at pre-post change from more to less healthy
Significant change toward more fresh fruit, less sugary desserts or snacks, fried foods, and whole milk. No significant change toward fresh vegetables, more skim milk

Physiological - None

Resnicow et al. 1992

Knowledge

Longitudinal cohort:

Control group knowledge significantly higher than intervention group knowledge.

Post-test cohort:

Significantly differences in knowledge by treatment group

Attitudes - (In Grades 4-6 only)

Health attitude - No significant difference

Self- efficacy - No significant difference

Behaviors

Six dietary indices derived from nonquantitative food frequencies

Longitudinal cohort:

Significant differences between treatment groups for dairy products and desserts when implementation levels combined.

Post-test cohort:

Significant difference in vegetable, heart healthy foods, and meat and dessert, comparing high implementation group with control group

Significant differences in desserts, vegetables, and heart healthy foods by treatment group.

Table 3
Study Outcomes (cont.)

Physiological

Total Cholesterol

Longitudinal cohort:

Significant difference by treatment group regardless of implementation level

Post-test cohort:

Significant difference between high implementation group and control group

BMI

Longitudinal cohort:

No significant difference

Post-test cohort:

No significant difference

Blood Pressure

Longitudinal cohort:

Significant difference by treatment group regardless of implementation level

Post-test cohort:

Significant difference between treatment groups

Wagner et al. 1992

Knowledge

Card Sorting Task (CST)

No significant difference in knowledge ($p=.10$ for snacks and entrees)

Attitudes

CST - Significant differences in snack preference

Behavior

CST - No significant difference in behavior ($p=.10$ for snacks and entrees)

Food Frequency Questionnaire

No significant difference ($p=.10$ for low-fat dairy, high-fiber grains)

Anliker et al. 1993

Knowledge

Significant differences in treatment groups for total knowledge score and 5/6 subscores

Attitudes - None

Behaviors - None

Physiological - None

Domel et al. 1993

Knowledge

Significant difference in knowledge gain between treatment conditions

Attitudes

Preference - Significant increase for fruit and fruit and vegetable snacks

Behavior

Food diaries - Significant treatment differences for fruits, vegetables

No significant differences total fruits and vegetables, juices, and legumes

Table 3
Study Outcomes (cont.)

Killen et al. 1993

Knowledge

Significant differences between treatment groups

Attitudes

No significant differences

Behaviors

Unhealthful weight regulation practices - No significant differences

Physiological

BMI- No significant differences, slight difference among high-risk students only

Resnicow et al. 1993

Knowledge

Significant difference between treatment groups

Attitudes

Nutrition awareness- (grade 1-2 only) Significant difference between treatment groups

Locus of control - (Grade 3-6 only) Significant difference between treatment groups

Importance of health screening (Grade 3-6 only) - No significant differences

Confidence in nutrition knowledge (Grade 3-6 only) - No significant differences

Behaviors - Non-quantified food frequency

Heart healthy food index - No significant difference

High fat food index - Significant difference between treatment groups

Physiological - None

Kelder et al. 1995

Knowledge - Significant differences between treatment groups at all grades and across both sexes except for males in eighth grade.

Attitudes - None

Behaviors

Food choice score - Females: Significant differences were seen between treatment groups at all grades except Grade 12;

Males: Significant differences were seen at all grades except Grades 11 and 12.

Food Salting Behavior - Females: Significant differences between treatment groups were seen at all grade levels;

Males: Significant differences were seen between treatment groups at all but Grades 11 and 12.

Physiological - None

Table 4
Suggested Nutrition Intervention Components

	Preoperational (Grades K-2)	Concrete operational Grades 2-6	Formal Operational (Grades 6-12)
<u>Environmental risk factors</u>	• Provide healthful foods in school environment • Involve parents in nutrition education through take-home exercises • Provide positive modeling through teachers and other adults	• Provide healthful foods in school environment • Involve parents in nutrition education through take-home exercises • Provide positive modeling through teachers and other adults • Begin discussions on media and social influences on eating behavior	• Provide healthful foods in school environment • Use peers as role models and in peer-led classes • Provide positive modeling through teachers and other adults • Teach students how to overcome barriers in the environment i.e., how to respond to media and social pressures
<u>Individual risk factors</u>	• Make basic connection between foods and health i.e., "You need food to grow and to feel good."	• Begin categorizing foods in food groups. Teach how to choose foods from a variety of food groups • Have children assess their diets using a food group approach. • Provide efficacy enhancing experiences i.e., using all food groups in planning a menu • Begin talking about why certain foods are preferred, what cues eating behavior	• Make connection between food and present, as well as future health. Focus on chronic diet/disease connections and diet/disease connections relevant to adolescents (i.e., calcium, iron) • Have students assess diets at a food and nutrient level; compare self assessments with RDA's, Dietary Guidelines, and Food Groups • Provide efficacy enhancing experiences i.e., planning and preparing a simple & quick meal, choosing a healthy fast-food meal. • Examine functional meaning of food. Keep a food diary noting what cued eating behavior (i.e., mood, hunger, stress, other people.

Table 4 (Continued)
Suggested Nutrition Intervention Components (Continued)

	Preoperational (Grades K-2)	Concrete operational Grades 2-6	Formal Operational (Grades 6-12)
<u>Behavioral risk factors</u>	• Have children prepare simple snacks • Use incentives and reinforcements for healthful food behavior. Do not consistently reward other behavior with food	• Have children prepare snacks or simple meal • Begin instruction on reading labels • Begin skill building related to decision-making • Use incentives and reinforcements for healthful food behavior • Set family goals for healthful food behavior	• Plan and prepare healthful meals • Read labels and discuss best choices • Teach self-management skills such as decision making and combatting social pressure • Have students identify incentives and reinforcements for their current eating behavior. Identify potential problem areas and set goals for more healthful behavior

Source: Lytle-Trenkner & Kelder, 1991

Figure 1
Recommendations made by previous review articles

Whitehead, 1957

1. Plan for specific problems
2. Appraise habits, beliefs, attitudes, and intake.
3. Use a behaviorally centered approach.
4. Use community resources as well as school-based resources.
5. Conduct rigorous nutrition education research using good methodology.

Saylor, Coates, Killen, and Slinkard, 1982

1. Incorporate proper scientific methods to protect researchers from undisciplined meandering through research questions and to provide the very important service of confirming what we do know or pointing out what we need to know.
2. Nutrition programs should include a statement of objectives, the development of conceptual frameworks, measurements of various teaching methods, subject selection and allocation into experimental and control groups, and incorporation of follow-up measures.
3. Educators should incorporate a variety of teaching methodologies, including both cognitive and behavioral techniques.
4. Family, peer, and community influence and resources should be used to help generalize the effects of programs and provide foundation and support systems.
5. Nutrition educators must strive for greater standardization and high quality in programs and subsequent reports.

Figure 1 (continued)

Lytle Trenkner and Kelder, 1991

1. While the majority of schools have some health curricula, very few have comprehensive health education curricula. The number of hours devoted to teaching nutrition is very limited.
2. School food service programs are recognized as an important component of a school health curriculum.
3. School health education may help to intervene on risk factors for chronic diseases. Modifications of psychosocial risk factors and behavioral factors are targeted in order to reduce the occurrence of physiological risk factors and morbidity and mortality.
4. Psychosocial risk factors, including environmental, individual, and behavioral factors are often primary targets for youth health promotion.
5. Studies of comprehensive school health promotion show evidence of ability to affect behavior change when a behaviorally-based intervention approach is used.
6. Nutrition education research show increasing rigorous study designs, although some methodological weakness such as lack of follow-up assessments, non-randomized treatment groups, and lack of validity assessment of measures persist.
7. Theories on children's health beliefs indicate that children younger than age eleven deal in concrete experiences rather than abstract associations. Health education curricula for children in grade 6 or less should focus on increasing exposure to a wide variety of foods, and on increasing the availability of healthful food choices. After grade 6, more abstract associations between nutrition and health are appropriate.
8. Children age 11 and younger will be motivated to choose foods based on availability, taste, social cues, and reinforcements. Older children begin to place a value on health and can recognize the connections between eating behavior and health. The teaching of personal responsibility and decision-making skills are appropriate content areas for older children.
9. Nutrition education should include longitudinal research tracking health habits and behaviors from childhood to adulthood.
10. Increased attention should be paid to hard-to-reach groups such as ethnic minorities, disadvantaged students, or the socially alienated.
11. Nutrition education should be presented within the context of a holistic health approach.

Figure 1 (continued)

Contento et al., 1992

1. Adequate time must be devoted to nutrition education. Sequential, multi-year programs are the most effective.
2. Behavioral changes are more likely to occur when nutrition education programs use active, behaviorally-oriented methods embedded in a sound curriculum based on Social Learning Theory.
3. Content of nutrition education should be appropriate in terms of cognitive development and the affective domain should be addressed.
4. Nutrition education programs for younger children should include a parental component.
5. Teacher training will improve the effectiveness of nutrition education.
6. There is a need for nutrition education research in testing programs of medium duration (lasting longer than a few weeks, but less than several years).
7. More appropriate measures should be used in assessing the diet and eating patterns of children.
8. Nutrition research studying the relative contributions of various program components and different educational methods is needed.
9. Qualitative research is needed to examine the motivations and concerns of children regarding eating behavior.
10. Research is needed to determine what strategies are most effective for different cultural groups.

Figure 2
Merging Behavioral and Cognitive Strategies in Nutrition Education
Using Cognitive Development Theory

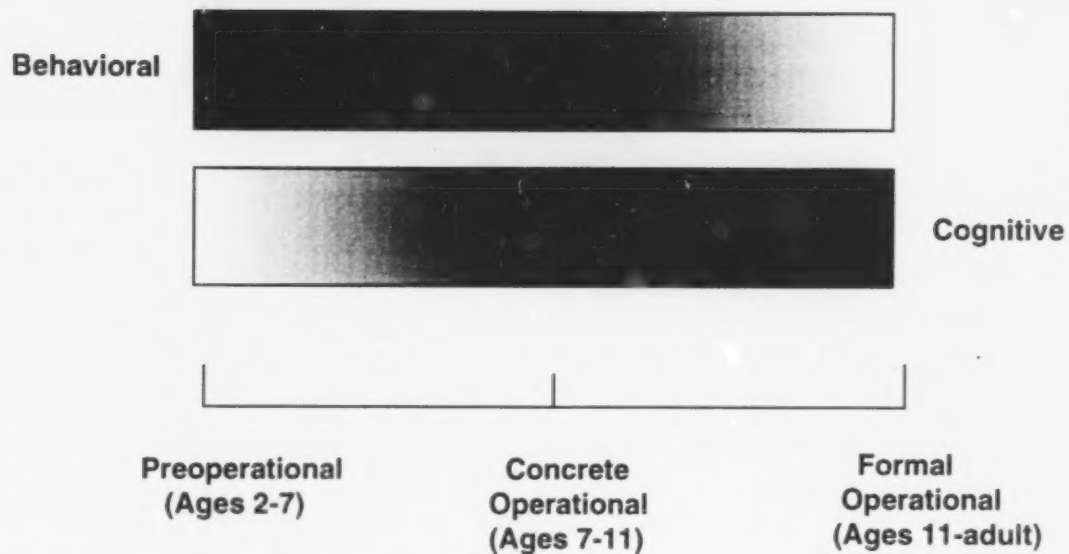


Figure 3
Psychosocial Factors for Youth Health Promotion

